INSTRUCTION MANUAL

SUBCARRIER DISCRIMINATOR

MODEL NO. 67D

MODEL NO. 67F

Electro-Mechanical e·m·r Research, inc.

SARASOTA, FLORIDA

INSTRUCTION MANUAL

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MODEL 67D
MODEL 67F

QC CAL/CERT
PROCEDURES
GROUP COPY

ELECTRO-MECHANICAL RESEARCH, INC.

SARASOTA, FLORIDA

WARNING

MODEL 67F DISCRIMINATORS MUST NOT BE OPERATED UNLESS BOTH 115 V SUPPLIES ARE ENERGIZED. (PINS 1 AND 2; PINS 3 AND 4).

FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN UNREGULATED B SUPPLY VOLTAGES WHICH EXCEED COMPONENT BREAKDOWN LIMITS CAUSING DAMAGE TO POWER SUPPLY PARTS.

ADDENDA AND ERRATA SHEET FOR MODEL 67 DISCRIMINATORS

ZERO-SIGNAL LIGHT

A zero-signal light has been added to the front panel of the Model 67 Discriminator in order to provide a "quick-look" indication of loss of usable signal.

As is explained in par. 14 of Section V, clamping tube V-305 conducts only when the subcarrier input signal is not of sufficient amplitude for operation of the discriminator. A portion of the resulting screen current flows through the zero-signal light, an NE-2D neon bulb.

Proper operation of the neon bulb can be checked by depressing the plastic cover of the indicator light. When a subcarrier signal sufficiently strong for proper operation is present at the input to the discriminator, the activation of this spring-loaded "press-to-test" switch has no effect upon discriminator operation because V-305 is cut off. When a zero-signal condition is suspected and the zero-signal light is not lit, the station operator may desire to ascertain whether the neon bulb is functioning. In such a case the activation of the "press-to-test" switch will--if the bulb does light--cause the discriminator output to go beyond full scale.

CONVERSION OF MODEL 67D MANUAL TO INCLUDE MODEL 67F

The Model 67F Subcarrier Discriminator is identical to the Model 67D in all respects except power-input transformer. The Model 67D has a transformer with one primary winding. The transformer in the Model 67F has two primary windings: One for a regulated input, one for an unregulated input.

This manual applies to both versions of the Model 67 if the following changes are made:

Page III-2. POWER SOURCE. Add: The center frequency of the Model 67D changes 1% per one-cycle change in power-line frequency. The Model 67F requires 105-125 volts, 55-70 cps, 175 watts, and 115 volts ±1%, 55-70 cps, 25 watts.

Page IV-2. POWER SOURCE. Change to read: The Model 67D Discriminator operates from a 200-watt source of 105-125 volts unregulated at 60 cps regulated. The Model 67F Discriminator requires two sources of power. One is a 175-watt source of 105-125 volts unregulated, at 55-70 cps unregulated; the other is a 25-watt source of 115 volts, regulated to within ±1%, at 55-70 cps unregulated.

Page VI-2. POWER SUPPLY, second paragraph. Change to read: The regulation of the regulated filament windings should be as shown on the schematic diagram and in Table I.

Table I. BROWN-ORANGE. Change to read: Regulated fil. ±1/2% on Model 67D, ±1% on Model 67F.

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SECTION III
DESCRIPTION AND INSTALLATION

1. GENERAL

The EMR Model 67 equipment is a replacement for existing subcarrier discriminators used in Frequency Modulated Telemetering and Data Recording Systems. This discriminator contains its Band Pass Input Filter, Tuning Unit, and Low Pass Output Filter in a single front panel plug-in unit. An additional insert unit is provided on this combined Frequency Determining Network to change F_c of the Low Pass Output Filter Section. The output voltage for full deviation is continuously variable over a wide range and is capable of driving most recording instruments. Each discriminator contains its own electronically regulated Power supply.

The discriminator is insensitive to spurious signals as large as 90% of the desired subcarrier signal. In addition to resulting in-channel improvements this characteristic greatly reduces the attenuation requirements of the Band Pass Input Filter.

The Model 67 Discriminator provides straight line linearity of constant slope and minimum zero drift. True base line limiting of the subcarrier eliminates amplitude modulation effects and reduces step function changes normally encountered in magnetic tape drop outs to a minimum.

Of special interest is the fact that this discriminator provides constant time delay of intelligence through a subcarrier channel. This permits reduction of recorded or transmitted dynamic data with errors of less than 1% distortion. As intelligence approaches D. C., error is reduced to 0.1% of bandwidth. Further, essentially complete speed change compensation of tape recorded data occurring at maximum RDB recommended deviation and intelligence frequency can be provided.

2. CHARACTERISTICS

The basic discriminator unit is operable over the frequency ranges and deviations stated. The Channel Selector Unit including Band Pass Input Filter, Tuning Unit, and Output Filter, establishes subcarrier center frequency, deviation, and intelligence bandwidth.

FREQUENCIES AVAILABLE:
Any center frequency in the range from 400 cps to 70 Kc. Extended low and high frequency ranges are available on special order.

SUBCARRIER FREQUENCY DEVIATION:
±7.5% and ±15% are standard. Up to ±50% of Center Frequency is available on special order.

INTELLIGENCE FREQUENCY:
RDB bandwidths are standard. From DC to as much as 30% of Center Frequency is available on special order.

REJECTION OF UNWANTED SIGNALS:
Discriminator response to modulation appearing on spurious co-channel subcarrier signals appearing after the band pass input filter whose amplitude is even as much as 90% of that of the desired subcarrier is negligible. The Discriminator low pass output filter rejects frequencies above f_c (low pass output filter cut-off frequency) resulting from beats between spurious and wanted subcarriers. The combination of these characteristics and the band pass input filter attenuation characteristics results in 50 db rejection of the modulation appearing on an adjacent channel carrier whose amplitude is 16 db greater than the in-channel subcarrier. In the extreme case of the 16 db stronger adjacent carrier, with full scale modulation, the resultant discriminator output is less than 0.1% of bandwidth.

TIME DELAY OF INPUT FILTER:
With ±7.5% deviation, delay is equivalent to approximately 4 cycles of subcarrier center frequency. With ±15% deviation delay is one half the value of that for ±7.5%. Total time delay variation within each pass band does not exceed ±0.75° of intelligence cut-off frequency based upon a modulation index of five. This value of variation is inversely proportional to modulation index.

HARMONIC DISTORTION:
Discriminator reduces data with a harmonic distortion of less than 1% for all channel intelligence frequencies up to channel cut-off as compared to errors as great as 10% imposed on such intelligence

by previous discriminator and filter systems. As intelligence approaches DC, accuracy improves to 0.1%.

INPUT IMPEDANCE:
0.5 megohms shunted by approximately 20 mmfd.

INPUT RANGE:
10 millivolts minimum. Larger inputs are controlled with input potentiometer. Dynamic range for any input level setting is 30 db.

AMPLITUDE MODULATION AND TAPE DROP OUT:
With the discriminator equipped for operation at a modulation index of five, 50% square wave amplitude modulation of the subcarrier results in a change in output amplitude equivalent to less than 1% of bandwidth. This effect increases proportionally as modulation index is decreased.

OUTPUT:
Output is single ended and referred to ground. The output for design deviation is continuously variable from ±6.6 volts to +90 volts with a maximum of ±25 ma. The output impedance is less than 10 ohms.

ZERO SIGNAL PROTECTION:
In the event that subcarrier is lost, adjustment is provided to return discriminator output to any range within design deviation.

LINEARITY OF OUTPUT VS. SUB-CARRIER FREQUENCY:
±0.1% of full bandwidth based on best straight line.

OUTPUT RESPONSE VS. INTELLIGENCE FREQUENCY:
Flat within ±0.5 db as a function of the standard Low Pass Output Filter. An output filter with Gaussian characteristics is available for use where commutated or step function data are to be handled.

AUTOMATIC CALIBRATION:
Provision is made for introduction of an external zero set and for externally controlling the output amplifier gain.

OUTPUT STABILITY:
±0.5% of full bandwidth in a 15-hour period after 15-minute warmup.

SENSITIVITY STABILITY:
±0.25% of bandwidth.

MAXIMUM OUTPUT NOISE:
Equivalent to less than 0.1% of bandwidth.

POWER SOURCE:
105 - 125 volts, 60 cps, 200 watts. No external regulation required.

PANEL SIZE:
5-1/4" x 19".

CHASSIS SIZE:
16-3/8" wide by 16-1/8" deep.

DEPTH BEHIND PANEL:
16-3/8" maximum.

WEIGHT:
50 pounds, complete with plug-in unit.

PANEL FINISH:
EMR Light Umber Gray.

3. INSTALLATION

The Model 67 Discriminator has been designed for standard rack mounting with or without slides. If slides are required the sides of the discriminator have been designed so that either pullout, non-turnover, or pullout, turnover Grant Pulley and Hardware Company slides may be used.

If pullout, non-turnover slides are required, brackets have been included on the discriminator sides for this purpose. To slide mount the discriminator the slides previously assembled in the rack should be fully withdrawn from the rack and the discriminator placed on the slides so that the discriminator brackets support the discriminator on the slides. The brackets should be secured to the slides with the screws provided. To slide the discriminator into the rack, release the stops by depressing the levers on the top of each slide.

When pullout, turnover slides are required, mount the two pivots and the indexing pin assemblies on the sides of the discriminator, using the proper mounting holes. The indexing pin holes on the front panel of the discriminator will have to be unplugged. To mount the discriminator in the rack, the rack slides should be extended out toward the front of the rack and the discriminators placed on the slides. Insert the two pivots mounted on each side of the discriminator into the U-shaped receptacle on each slide. When the pivots are nearly into the slide, pull out the two indexing pins on the sides of the discriminator away from the front panel. When the discriminator pivots are fully engaged in the slides, the attached retainers should be inserted over the pivots

to hold them in place, and screwed down. To slide the discriminator into the rack, push in on the indexing pins on the sides of the discriminator panel.

When slides are not used, the discriminator may be mounted in the rack by providing brackets in the rack for supporting the discriminator on the brackets included on the sides of the unit.

In either case, the discriminator is held in the rack by means of lock fasteners on each side of the front panel.

The open center section of the discriminator chassis, into which all tubes and other heat producing components project, permits efficient cooling of the discriminator. The airstream of a rack ventilator may be directed through the duct formed by the center section of several discriminators mounted in a rack.

SECTION IV
OPERATING PROCEDURE

1. GENERAL

The discriminator operates in telemetering systems where the input signal is a frequency multiplexed, complex wave containing several subcarriers, each modulated with its own intelligence frequency. One subcarrier channel is assigned to each discriminator and an appropriate bandpass filter is inserted in the discriminator to select from the complex input signal only that channel to which it is assigned. In order that the discriminator operate about the desired center frequency, the discriminator tuning capacitor, C-1306, must also be included with the bandpass input filter chosen. The bandpass input filter and discriminator tuning capacitor are included in a single front panel plug-in unit called the Channel Selector. The discriminator power need not be turned off before the plug-in unit is removed or inserted. The bandpass input filter not only selects the appropriate subcarrier channel, but also provides amplification of the subcarrier signal. Since the intelligence output of the discriminator circuits is accompanied by the subcarrier frequency, it is necessary to include a low pass output filter between the output of the discriminator circuit and the load. The components which determine the low pass output filter frequency and attenuation characteristics are contained in a separate insert unit which is inserted into the Channel Selector unit and secured there by means of a fastener. The complete Channel Selector unit consisting of band pass input filter, frequency determining network and low pass output filter is inserted into the discriminator front panel opening to provide operation about any center frequency.

Physically, the Model 67 discriminator is divided in two sections, the rear section containing the power supply and the chassis to rack connector and the front section containing the discriminator circuitry. The top and bottom views of the unit as well as the location of major components are shown in the Component Location Drawings. The center region between these two sections is completely open, so that when the unit is rack mounted air will circulate about the tubes and other heat producing components projecting into the center region. When several units are rack mounted, the open center sections provide a duct through which air may be directed by means of a blower.

The power supply is electrically connected to the front chassis discriminator circuitry by several cables. With the exception of the input shielded cable most wires from the power supply terminate at terminals 1 through 22 on the front of the band pass input filter card located on the underside of the front chassis unit. These connections are indicated on the circuit schematic as numbered squares.

2. INPUT AND OUTPUT CONNECTIONS

Input and output connections are made through the Cannon plug located on the rear chassis skirt. A Cannon number DPD-D32C2-33S-1L receptacle is required for connection to this plug.

The subcarrier input is provided on the coaxial input Pin A-1 at the rear connector.

The output is provided on either Pin 7 or 8 of the rear connector.

3. INPUT LEVEL CONTROL AND MONITOR

The "Input" control R-120 located on the front panel permits attenuation of large input signals to an optimum operating range for the bandpass input filter. This range is indicated by the green area of the "Input Level" meter. An input signal over 10 millivolts rms will produce proper discriminator operation, although for such low signals the input level meter may register below the green area. Since signal amplitude variations might cause operation dropouts it is preferable not to operate in this low signal region unless the signal level is quite constant.

4. LOW PASS OUTPUT AMPLIFIER

a) FRONT PANEL OUTPUT CONTROL

The output voltage for full bandwidth deviation is controlled by means of the concentric switch and variable resistor SW-401 and R-447 located on the front panel. The pointer on the switch indicates the range of output voltage given on adjacent sides of the pointer position markings on the front panel. The concentric control R-447 will vary the output voltage over the range indicated for any of the first five switch positions. With this arrangement, the output voltage for full

bandwidth deviation can be continuously varied from about ±6.6 volts to ±90 volts.

NOTE: For the first five positions of SW-401 to be operative, the feedback path of the second output amplifier section must be completed through the external #1A and #1B leads by connecting Pins 24 and 25 on the Cannon connector.

The sixth switch position is labeled "EXT" and provides an opportunity to replace the entire feedback output control system of SW-401 and R-447 with an external system so that remote control can be achieved.

The output impedance for all voltage ranges and frequencies is under 10 ohms. The maximum current load should not exceed ±25 ma. No output impedance matching is required.

In all positions of SW-401 and R-447 the output meter M-401 will read percent deviation from band center to band edge since it is connected to the feedback point.

NOTE: For Position 5 of SW-401 with R-447 full clockwise somewhat more than ±90 volts for full bandwidth deviation may be obtained on some units. Since full output specifications including linearity are not necessarily maintained much beyond the ±90 volt point, R-447 should be adjusted back to this point when full deviation is to be used.

b) EXTERNAL GAIN CONTROL

The gain of the second section of the output amplifier may be controlled externally in two ways.

First, with the Output Gain Control Switch SW-401 in any of the first five positions, the gain may be varied upward by adding an additional resistor divider to ground from the external #1A lead on Pin 25 of the Cannon connector as shown schematically in Dwg. B-01983. The center point of this additional external divider is returned to the amplifier feedback point through the external gain #1B lead on Pin 24 of the connector.

NOTE: The external leads used for connecting the external divider should be low capacity shielded cable and the sum of the shield capacity to ground be below 700 mmf.

If a portion of this external resistor divider is made a potentiometer with the arm returned to the feedback point, this arrangement has the advantage that a given variation in the potentiometer arm position will vary the output gain the same percent, independent of the output gain control setting of SW-401 and R-447.

The total value of this external divider should preferably be between 10K and 20K ohms so that the lower portion of the internal divider across which the external divider appears will not be shunted down excessively. A condenser of about 1000 mmf should be connected from the top of the external feedback divider (External Gain #1A input) to the feedback point (External Gain #1B).

By this method, the gain may be varied upward from that given by any setting of the internal controls SW-401 and R-447. The maximum setting made by means of this external control should not exceed by more than about 30% the gain achieved without the external control. Otherwise the divider will draw excessive current from the output for full bandwidth deviations, thus lowering the maximum output current capability.

With the Output Gain Control Switch SW-401 in the "EXT" position a second method of externally varying the gain of the second section of the output amplifier may be obtained. In this position the feedback point of the second amplifier section is returned to Pin 10 of the Cannon connector via the External Gain #2 lead as is also shown in Dwg. B-01983. In this position the amplifier is inoperative unless feedback from the output on Pins 7 or 8 is introduced externally to Pin 10. Suitable external feedback divider resistor values for specific gain ranges should approximate those used on SW-401. Capacities across the upper divider arm of the external divider should be used with comparable values to those used on SW-401. By using this position for external gain all other positions remain for normanl control with SW-401.

NOTE: The external lead used for the feedback return to Pin 10 must be low capacity shielded cable of less than 700 mmf total capacity to ground.

If the "EXT" position #6 of SW-401 is not used, it is advisable to jumper the output on Pins 7 or 8 to Pin 10 so that the output stage will not saturate if the switch is inadvertently thrown to "EXT".

5. POWER SOURCE

The Model 67D discriminator operates from a 115v ±10v 60 cps single phase source. Since the power supply of the discriminator is internally

regulated, no external regulation is needed provided that the power source is within the range 105v to 125 volts at 60 cycles.

6. POWER SWITCH

After the discriminator has been connected to the mating receptacle in the rack, it may be turned on by means of the power switch on the front panel. The panel light indicates that power has been applied.

7. MAGNETIC RECORDER-REPRODUCER TAPE SPEED ERROR COMPENSATION

The ground of the discriminator time constant control resistor R-1332 is returned through Cannon connector pin 22 at the rear of the discriminator. For normal operation without compensation, this point must be connected to ground (pin 15 or 30). When Magnetic Tape Speed Error compensation is to be applied, this pin should be removed from ground and connected to the compensation system output.

8. CENTERING CONTROL

The discriminator center Balance control is located on the front panel of the Channel Selector Unit. With a known input frequency such as the center frequency, this control should be adjusted to provide the desired output voltage. (0 volts for the center frequency.) The output meter on the panel may be used in this adjustment, but the dial is quite small and accuracy may be sacrificed accordingly. Since the balance control is a ten-turn unit, output voltage adjustments to a tolerance closer than 0.1% of full bandwidth may be achieved.

9. ZERO SIGNAL BALANCE CONTROL

With no input signal to the discriminator, the Zero Signal Balance control may be set so that the output meter reads zero. Adjustment of this control in no way affects the discriminator Balance control.

10. CALIBRATION CHECK

Although the calibration may be checked by various methods, a 3-point check should be sufficient. If the discriminator is first adjusted for zero output at the center frequency, the outputs at the two band edges should differ by less than 0.2% of full bandwidth indicating a maximum error of 0.1% or less. It is of primary importance that the calibration frequencies be accurately determined and that the output voltage measuring device be extremely accurate to determine this degree of calibration precision.

11. INPUT MONITOR

The input signal may be monitored on pin 27 of the Cannon output connector at the rear of the chassis or at the Input Test jack located on the front panel of the discriminator. The signal level at this point will be of the order of 1 volt RMS for an input level of approximately "50" on the input level meter. The level will, of course, depend on the input signal strength and the setting of the Input control. The impedance at the monitoring point is approximately 800 ohms.

In addition to the subcarrier level meter located on the front panel, the input level may be monitored remotely by connecting a meter to pins 5 and 6 of the Cannon rear chassis connector. A jumper must be placed across these pins when the external meter is not used.

The Input Test jack located on the front panel of the discriminator does not provide a ground connection when the jack is used. This ground may be obtained by clipping a ground lead to any place on the chassis.

12. OPERATING SIGNAL LEVEL AND TAPE DROP OUT

Since the linear range of the input amplifier over which limiting occurs is greater than 30 db, the discriminator will often provide an output before the input level meter has reached 1% of full scale. While the unit will operate satisfactorily under these conditions it is preferable to operate above "6" on the input meter to insure limiting signals with small amplitude variations.

When the input subcarrier signal has large amplitude modulation, the input level should be adjusted by means of the input control to about 40 on the input level meter. This will provide optimum amplitude rejection.

If, however, the amplitude variation of the input signal is extremely large, such as can be encountered by tape recorder-reproducer dropouts it might be preferable to operate with the input level meter between 75 and 85. This would make full use of the dynamic operating range of the discriminator.

13. OUTPUT TEST JACK

The Output Test jack located on the discriminator front panel is internally connected to the output of the low pass filter output amplifier. Since the Output Test Jack does not provide a ground connection a ground lead must be clipped

to the chassis. The Output Test point will be negative with respect to the chassis when a subcarrier signal higher than center frequency is applied to the discriminator.

14. LOW PASS OUTPUT AMPLIFIER EXTERNAL ZERO SET

Provision is made to vary the zero-output position of the low pass output amplifier by injecting a suitable voltage on Pin 19 of the rear Cannon connector. This voltage is impressed on the grid of V-401A through a 425K resistor R-1438 contained in the low pass output filter insert unit. A ±1 volt signal will vary the output about ±12% of bandwidth.

An external zero offset voltage should be provided through a shielded cable from a source impedance under 5,000 ohms.

NOTE: When the external zero offset is not being used Pin 19 must be returned to ground.

15. LOW PASS OUTPUT AMPLIFIER BALANCE ADJUSTMENT

In order that the gain of the second section of the Output Amplifier may be varied by SW-401 and R-447 without affecting the output zero position, the amplifier must have zero output with zero input. This adjustment is made by pushing the slotted Amp. Bal. shaft on the front panel in as far as it will go with a screwdriver and rotating the shaft until the output is exactly zero volts. Pushing in the shaft shorts the input to this second amplifier section by SW-402, and engages the shaft of R-450 so that rotating the shaft adds or subtracts a voltage to or from the amplifier through R-1441.

SECTION V
THEORY OF OPERATION

1. GENERAL

The essential stages of the discriminator consist of a bandpass input signal filter and amplifier, limiter, pulse generator, trigger circuit frequency discriminator and low pass output filter amplifier as shown by the block and waveform diagram. The entire circuit is shown schematically on the circuit diagram. Important waveforms are indicated on both of these drawings. In order that a large number of units may be operated in parallel on different channels, the input impedance has been made high (500 K ohms).

The bandpass input filter consists of four stagger tuned L-C circuits located between V-101A and V-103A. V-103 is a voltage amplifier to provide the required amplitude of subcarrier signal level to the limiter circuit. The limiter circuit V-201, V-202 and V-203 provides a square wave output to the pulse forming stage V-301, which in turn triggers the discriminator at the plate of V-302. The circuits associated with V-302, V-303 and V-304 constitute the frequency discriminator. Cathode follower V-303A serves the dual purpose of providing a low driving impedance for the RC network of the frequency discriminator as well as a low impedance output to the low pass output filter amplifier. The low pass output filter amplifier V-401, V-402, V-403, V-404, V-405 and V-406 removes the subcarrier frequency from the intelligence frequency and provides a low impedance output for the discriminator at the cathode of V-406. This output with a source impedance of less than 10 ohms is designed to supply from ±6.6 volts to ±90 volts currents up to ±25 milliamperes for full bandwidth deviation. The input level meter is actuated by the circuit containing the diodes D-101 and D-102. V-305 provides low pass filter output amplifier clamping to any desired point when the subcarrier signal to the discriminator is zero. V-1 and V-2 are the power supply rectifiers and V-3, V-4 and V-5 and V-6 constitute the voltage regulator circuits to provide a constant B+ and B- voltage to the discriminator circuits.

2. INPUT BANDPASS FILTER AND AMPLIFIER, V-101, V-102 AND V-103

The input circuit is designed to accommodate any subcarrier input level from 10 millivolts to 10 volts, the input attenuator reducing larger amplitude signals to an optimum level. Overloading of the input circuits and bandpass filter is thereby avoided and the possibility of intermodulation is greatly reduced. The bandpass input filter which consists of four tuned L-C circuits, each separated by cathode followers V-101 and V-102, is adjusted for a gain of approximately 15. A typical attenuator curve of the filter, measured between the input and the plate of V-103B is shown in B-01875. The voltage amplifier circuit, V-103, is designed to provide a gain of approximately 20, and its output will remain linear for voltages as high as 35 volts RMS. This linearity is realized by the use of a large amount of negative feedback within the amplifier. Amplifier frequency response is flat to ±1 db from 400 cycles to 100 Kc.

3. CHANNEL SELECTOR UNIT - BAND PASS FILTER COMPONENTS

The Channel Selector Unit contains all of the components which are necessary to provide a band pass input filter with the required attenuation and phase characteristics. These components are L-1101 through L-1104, C-1102, C-1104 through C-1106, R-1104, R-1106, R-1108 and R-1110. Bandwidth of ±7.5% and ±15% are normally provided, although other bandwidths can be supplied to order.

4. INPUT LEVEL METER

The Input Level is applied to the rectifier bridge circuit formed by the diodes D-101 and D-102 and R-117 and R-118. This bridge is supplied from the low impedance cathode of V-103B through the condenser C-103. Because of the large linear range of amplifier V-103, the meter will indicate limiting with deflections of the order of 1% of full scale. The linear range of this amplifier extends to approximately 85% of the meter scale. As V-103 saturates, the meter will approach full scale, but it cannot be damaged by large input signals.

5. LIMITER AND PULSE GENERATOR, V-201, V-202, V-203 AND V-301

The limiter circuit V-201, V-202, V-203 is designed to produce a square wave whose positive excursion occurs simultaneously with the input sine wave zero axis crossing in the positive-going direction. The amplifier V-201 is designed

to provide a large amplification of the input signal sine wave for plate excursions of approximately ±20 volts. Beyond this plate excursion range one of the diodes of V-202 conducts and reduces the gain of amplifier V-201 to approximately unity, thus preventing any further large plate excursions. Thus, for limiting sine wave signals, the signal on the plate V-201 approximates a square wave whose sides coincide with the zero axis crossing of the input sine wave. This approximate square wave then triggers the cathode coupled bistable multivibrator V-203. The output of this trigger circuit is selected from the unloaded plate of V-203B, which because of the cathode coupling is free of capacity and therefore produces a good square wave.

Because this limiter circuit triggers only when the incoming sine wave crosses the zero axis, the output will be unaffected by variations in input signal levels over the entire linear range of the amplifier V-103. Since limiting occurs with between 0.4 and 1.0 volts rms on the plate of V-103B, and this amplifier remains linear to at least 35 volts rms, a dynamic input operating range of greater than 30 db is provided. This permits the limiter to reject large scale amplitude modulation almost completely. When the input signal to the grid of V-101 falls below approximately 5 millivolts limiting will fail and the discriminator will become inoperative.

The output of the limiter is fed to V-301 through the pulse forming circuit C-209 and R-301. V-301 is biased beyond cutoff so that the negative grid pulses do not appear at the discriminator. Each positive grid pulse triggers the discriminator through the plate coupling of V-302.

6. TRIGGER CIRCUIT DISCRIMINATOR, V-302 V-303 AND V-304

In the absence of pulses from V-301, the discriminator circuit is inoperative, with V-302 cutoff and V-304 conducting by virtue of their respective grid and cathode return circuits. In this condition, the diode V-303A conducts and the plate voltage of V-302 is fixed at approximately +100 volts through the resistance divider R-307, R-310 and R-311. This condition also maintains the cathode of V-303B at +100 volts. The circuit passes through one cycle of operation for each trigger pulse from V-301, the pulse being applied directly to the plate of V-302 and through diode V-303A, cathode follower V-303B and C-1306 to the control grid of V-304. The amplitude of the pulse applied to the grid of V-304 is maintained constant because diode V-303A ceases conduction after the plate of V-302 becomes more negative than -100 volts. With V-304 thus cutoff, its plate rises to approximately 160 volts applying positive grid bias to V-302 through R-309. In this conducting condition the plate of V-302 falls to approximately -170 volts while the cathode of the diode V-303A is maintained at approximately -100 volts by R-310 and R-311. This also maintains the cathode of the cathode follower V-303B at approximately -100 volts. In this manner, the circuit will remain in this condition for a specific constant time until C-1306 discharges through R-1314 and R-1322 sufficiently to start conduction of V-304. The circuit then returns abruptly to the initial condition where it awaits the next pulse of V-301. Thus the ±100 volts on the cathode of V-303B corresponding to the two discriminator circuit conditions is dependent only on the precision of resistors R-307, R-310, R-311 and the stable B+ and B- voltages, and not upon the conduction characteristics of the tubes V-302 or V-304. Since V-301 and V-302 are completely cutoff before a trigger pulse these tubes do not affect the +100 volt condition of the cathode follower V-303B. The filaments of V-303 are regulated to prevent variations in the cathode follower output V-303B.

R-1322 provides an adjustment of the output at center frequency since it affects the time constant during which V-304 is saturated and V-302 is cutoff, following each trigger pulse. This resistor is referred to as the Balance Control.

7. CHANNEL SELECTOR UNIT - DISCRIMINATOR COMPONENTS

The Channel Selector Unit contains all of the components which must be selected to establish operation at a given subcarrier center frequency with a corresponding intelligence pass band. The channel frequency is determined by C-1306, R-1314 and R-1322. The resistors R-1401 and R-1443 are the input resistors for the low pass output filter circuit and determine the output sensitivity for a given intelligence pass band. A table showing the values of C-1306 required for the various subcarrier center frequencies is included in the drawings contained in this manual.

8. LOW PASS FILTER AMPLIFIER, V-401, V-402, V-403, V-404, V-405 AND V-406

The low pass output filter amplifier consists of two cascaded computer-type operational amplifiers. The open loop gain of each amplifier is approximately 90 db, thus providing a highly stable amplifier when the gain is adjusted through the feedback components to be approximately unity. In addition, the filaments of the input tube to each amplifier, ie. V-401 and V-403, are regulated. The frequency response and gain characteristics

of the amplifiers are determined by the capacitor and resistor networks at the input to each amplifier. These are R-1443, R-1401 through R-1404 and C-1401 through C-1403 for the first amplifier consisting of V-401 and V-402. The network for the second amplifier of V-403, V-404, V-405, and V-406 consists of R-1419 through R-1422 and C-1410 through C-1412 in addition to the feedback divider networks included on the Output Gain Control Switch Sw-401. The resistor-capacitor network shown in the schematic circuit diagram are those employed for the standard low pass output filter characteristics. Since all of them but the feedback divider networks (which have no bearing on the frequency response) are included in the Channel Selector Unit insert plug-in, other frequency and gain characteristics may be obtained by employing a variety of networks.

The dc gain of each section of the output amplifier is determined approximately by the ratio of the feedback resistor to the input resistance divided by the amount of the output that is fed back. For the first amplifier the ratio is R-1404 to R-1401 plus R-1402 which is nearly one and since all of the output is fed back the dc gain of this section is unity. For the second section the ratio is R-1421 to R-1419 plus R-1420, again nearly unity, but here the amount of the output that is fed back is varied by the divider networks on SW-401 or by externally provided dividers. For example, in the highest gain position #5, with R-447 full clockwise, the amount of output feedback is the ratio of R-446 to R-452 plus R-447 which is about 1/15.7. Thus the gain of the second section is about 15.7 in this position.

The actual values of these feedback divider resistors have been chosen to not excessively load the output.

The capacitors C-424 to C-428 have been shunted across the upper legs of the feedback dividers to maintain stability of this output amplifier section. If external feedback divider networks are used ("EXT" position of SW-401) these capacities should be added with values similar to those used on SW-401.

The output stage of the second amplifier section operates with V-406 driven by V-404 as for a normal cathode follower, but V-405 replaces the usual passive cathode resistor with an active element. This permits large positive output voltages at currents up to 25 ma with a comparatively small current drain from the negative power supply since V-405 tends to cut off as the output goes positive. Conversely, the current through V-406 tends to decrease as the output goes negative to -90 volts, the added load current being drawn from the negative supply through V-405.

The coupling diodes D-401A and D-401B are silicon diodes operated in the zener region providing direct interstage coupling from V-403B plate to grids of V-404 and V-405 without loss of gain.

The bias supply of the second amplifier section required for the negative grid return of V-404 and V-405 is provided by rectifying the ac voltage of one side of the B+ supply transformer T-1 winding. D-402 is a 90-volt zener silicon junction diode used as a regulator to stabilize the bias supply at about -90 volts below its B- return.

9. LOW PASS OUTPUT FILTER AMPLIFIER ZERO SET

The output setting for band center operation is varied externally by injecting a voltage through R-1438 to the first section of the output in the normal operational-amplifier manner. An analysis of this particular network condition results in a gain of about 1.5 for a voltage impressed through R-1438 for this first amplifier section. Since any spurious signals appearing at this input will appear at the output it is necessary to use shielded cables for this input.

10. LOW PASS OUTPUT FILTER AMPLIFIER EXTERNAL GAIN CONTROL

The method of externally varying the gain of the second amplifier section is identical to that used when varying it with the controls SW-401 and R-447, ie. The feedback divider ratios are varied. In Positions #1 through #5 for SW-401, either resistor leg of the dividers on SW-401 may be shunted with resistance externally. In the "EXT" Position #6 of SW-401 the entire feedback divider must be provided externally. These two ways of externally controlling the gain are shown in Drawing B-01983.

11. LOW PASS OUTPUT FILTER AMPLIFIER BALANCE ADJUSTMENT

If the gain of the second section of the output amplifier is varied as described above, an analysis of the feedback loop will show that the offset voltage will remain constant with gain only when the voltage appearing at the feedback point of the feedback divider exactly equals the input voltage to the amplifier, i.e., at R-1419. For all other conditions the difference between the input voltage and the feedback voltage will be amplified by the amplifier, and varying the gain will vary the amount of this difference appearing at the output. The input and feedback voltages can be made identical by adding a small voltage through R-1441. The amount is determined by referencing the input to ground through SW-402 and adjusting the added voltage from the potentiometer

R-450 until the output is zero volts. In this condition then the feedback voltage equals the input voltage.

12. OUTPUT LEVEL METER

The output level meter M-401 is connected to the feedback point of the second output amplifier section through R-408. The value of R-408 is such that for the condition of 100 per cent feedback (i.e. SW-401 in Position #1 and R-447 full counter clockwise) the output meter reads full scale for an input voltage to the second amplifier section corresponding to full bandwidth deviation. Since the gain of this section is determined by the feedback divider ratio the voltage at the feedback point of the divider will remain the same as in the 100 per cent case independent of the divider ratio. Hence the output meter always reads percent deviation from band center, independent of the output amplifier gain setting by SW-401 and R-447.

13. CHANNEL SELECTOR UNIT - LOW PASS OUTPUT FILTER COMPONENTS

The resistor and capacitor networks necessary to provide the proper frequency and gain characteristics for the low pass output filter amplifier are contained in a separate insert unit. In addition the resistors R-1438 through which the external zero offset is added and R-1441 through which the amplifier balance signal is added are also included in this insert (for 67DL series inserts). This unit is normally inserted in the Channel Selector Unit and held there by means of a fastener. The combined Channel Selector Unit and insert is inserted in the front panel opening of the discriminator chassis and held there by means of two screw fasteners.

The output sensitivity is adjusted for any given subcarrier pass band deviation by the resistor network R-1401 and R-1443. For example, for a ±7.5% channel R-1401 is 100K and R-1443 is omitted. For a ±15% channel, R-1401 and R-1443 are both 200K in order to provide a 50% attenuation of the intelligence appearing on the cathode of V-303B. In any case the impedance to C-1401 must be 100K.

This low pass output filter amplifier serves several purposes. It removes the subcarrier frequency from the intelligence, and by the choice of the proper intelligence frequency, it removes a great deal of the noise normally present in the FM/FM system. Finally, it provides a low impedance output capable of driving most standard type recording instruments.

Since the Channel Selector Unit insert plug-in is provided with leads to the rear Cannon connector of the discriminator chassis and to the low pass output filter amplifier, either or both amplifiers may be employed as the low pass output filter unit. This permits a variety of frequency and phase attenuation characteristics to be used.

14. ZERO SIGNAL CLAMPING CIRCUIT, V-305

When a zero input subcarrier signal is applied to the discriminator, the discriminator circuit becomes inoperative and V-302 remains in a cut-off condition. Since the screen of V-302 is connected to ground through R-306, the screen will be at zero potential when the tube is cutoff. When V-302 is conducting, however, the screen drops to approximately -140 volts. Therefore, when the discriminator is being triggered by subcarrier signals, the screen potential will average approximately -70 volts. This screen voltage is applied through R-318 to the grid of V-305 the cathode of which is clamped by the resistor divider network R-316 and R-323 to voltages which can be varied from zero to approximately -40 volts by means of resistor R-323. This adjustment may be made by rotating the zero signal balance control on the front panel of the discriminator. When a zero signal is applied to the discriminator and the screen of V-302 rises to ground potential V-305 will be put into a conductive condition. The plate of V-305 is connected to the junction of R-1401 and R-1402 at the input of the low pass output filter amplifier. In this condition, the voltage drop across V-305 is less than 10 volts which means that the input to the low pass output filter amplifier will be clamped to a voltage approximately 10 volts greater than the cathode of V-305. When the discriminator is supplied with an input signal, however, the average -70 volt potential that the screen of V-302 approaches during operation is sufficient to completely cut off the clamping tube V-305. In this condition, the plate impedance is nearly infinite and thus will not affect the operation of the low pass output filter amplifier.

15. TAPE RECORDER-REPRODUCER SPEED CHANGE ERROR COMPENSATION

The ground return of the discriminator time-constant control-resistor R-1322 is returned through Pin 22 the Cannon connector at the rear of the discriminator. For normal operation, this point is returned to ground by a jumper on this connector. However, tape recorder-reproducer speed change error compensation can be accomplished by returning this point to a voltage output from a Model 67 compensation reference discriminator with a special low pass filter insert unit. An accessory unit, the EMR Model 96 twelve-channel compensation unit provides the necessary time delay and amplitude adjustments.

16. POWER SUPPLY, V-1, V-2, V-3, V-4 AND V-5

The B- supply is electronically regulated by V-5, V-6 and V-3B. V-5 supplies a fixed reference voltage for the regulator amplifier V-6 and V-3B. V-3B acts as the current regulator for the B- supply. The ripple content of the supply is extremely low due to a special bridge balance circuit incorporated in the screen circuit of V-6B. Resistors R-21, R-22, R-24, R-23 and capacitor C-11 constitute this bridge circuit. This design achieves a null in the ripple voltage of the B- supply.

The B+ supply is similar to the B- with the exception that it is referenced from the B- supply. V-5 supplies the reference for the B+ supply and the cathode of V-4A is returned through R-3 to the B- supply. The ripple voltage of the B+ supply is nulled through the resistance divider network R-7, R-8 and R-9 located in the screen circuit of V-4B. The filaments of both V-4 and V-6 are regulated to further increase the stability of the B+ and B- supplies.

The regulated filament windings are supplied from the main power transformer T-1 as can be noted on the Schematic Circuit Diagram.

SECTION VI
MAINTENANCE

1. INSPECTION

The Model 67 subcarrier discriminator should be subjected to a regular inspection program similar to that recommended for other types of electronic equipment. A visual inspection should be made each week, checking for loose components and evidence of overheating; and a complete inspection every six months should include the following:

a. Test all vacuum tubes.
b. Tighten all screws.
c. Inspect wiring for loose connections and evidence of overheating.
d. Check all tube socket voltages.
e. Check performance.
f. Replace defective components.

2. VOLTAGE MEASUREMENTS

All DC and AC voltage measurements may be made using the chassis ground as a reference. Tube socket voltages are given in Section VII.

3. PERFORMANCE TESTS

Most of the important characteristics of the discriminator may be determined by performing the tests described below. The inspection record may be used in connection with these tests. An audio frequency oscillator, vacuum tube RMS voltmeter, input attenuator, oscilloscope, accurate means for measuring 0 to 30 d-c milliamperes and 0 to 100 volts dc and equipment to measure frequency to within 0.02% should be used in conducting these tests. An Electro-Mechanical Research Model 40C or Model 40D frequency calibrator is recommended as a signal source which meets the requirements for these tests. The set should be placed in operation in accordance with the conditions and the procedure outlined under Installation and Operating Procedure.

The physical layout including tubes and component cards is shown on drawings in Section VII, Tables & Drawings.

a. V-103 AMPLIFIER GAIN, FREQUENCY RANGE AND DISTORTION

With the Channel Selector Unit removed, the signal from a low impedance source audio oscillator should be injected on the grid of V-103A (pin 8 of the Channel Selector plug). The gain of this amplifier is measured at the plate of V-103B. The gain should be approximately 20 and should be flat to about ±1db over the frequency range of 400 cycles to 100 Kc. Since the additional capacity of a measuring probe on the plate of V-103B will offset this response it is best to check the amplifier by measuring the signal on the cathode of V-103B, ie. the input monitor point. The amplifier should be linear to 35 to 40 volts RMS output on the plate V-103B and this level should correspond to an input level meter reading of approximately 85.

b. BANDPASS INPUT FILTER GAIN AND FREQUENCY CHARACTERISTICS

With the input attenuator turned fully clockwise and a Channel Selector Unit inserted in the discriminator, the voltage gain to the plate of V-103B amplifier should be in the range of from 100 to 400. The gain of the bandpass input filter as measured at the plate of V-103B should not be more than 4 db nor less than 2 db at either band edge as measured from the maximum gain point within the band. Further, the curve of attenuation vs. frequency should be reasonably symmetrical about the maximum gain point. The gain should be down approximately 20 db measured from the maximum point at the lower band edge of the next higher band and the upper band edge of the next lower band. A typical attenuation vs. frequency characteristic curve is illustrated in Section VII, Tables & Drawings.

c. BANDPASS INPUT FILTER TIME DELAY VARIATION

The bandpass filter contained in the Channel Selector Unit has been adjusted so that the total time delay variation of the maximum intelligence frequency based upon a modulation index of 5 does not exceed ±0.75° of one cycle. The variation is inversely proportional to modulation index. It is necessary to achieve this degree of constancy of the time delay of the intelligence in order to maintain the harmonic distortion of the intelligence at all frequencies below cutoff less than 1%.

CAUTION: The bandpass input filter components mounted in the Channel Selector Unit are critical in their adjustment. Therefore, the Channel Selector

Unit should be returned to the factory when adjustment is necessary.

d. LIMITER SENSITIVITY

As the input level is decreased, very little change should result in the output until triggering of the limiter begins to fail. This failure should occur below approximately 5 millivolts input with a standard Channel Selector Unit plugged in.

e. OUTPUT AMPLITUDE AND LINEARITY FOR THE STANDARD CHANNEL SELECTOR UNIT WITH A STANDARD LOW PASS OUTPUT FILTER INSERT

The output for a ±7.5% or ±15% frequency deviation should be ±6.0 to ±6.9 volts with SW-401 in Position #1 and R-447 full counter clockwise. The voltage ranges indicated on the front panel should be obtained approximately for each SW-401 position and proper rotation of R-447. Each range should provide overlap. Output variations from unit to unit for full deviation for a given position are caused largely by tolerances in the tube characteristics of V-303B and the value of the positive and negative supply voltage.

For channels in which the deviation is ±7.5% or ±15% of the subcarrier frequency, the linearity of output vs. frequency should be within ±0.1% of full band width based on the best straight line. In order to measure the linearity to this degree of accuracy, the input frequency must be known to an accuracy of 0.02% and the output voltage measuring device must be accurate to within 0.02%. In order to observe voltages to this degree of accuracy, a potentiometer-null method is usually employed.

f. LOW PASS OUTPUT FILTER AMPLIFIER

The low pass output filter amplifier may be checked for individual performance by plugging in only the low pass output filter insert into the discriminator and not the complete Channel Selector Unit. A signal may be injected from a low impedance audio oscillator through a precision 100K resistor on pin 13 of the Channel Selector Unit connector. For this test, the clamping tube V-305 must be removed. The gain and frequency characteristics of the low pass output filter amplifier may then be observed at the output, (Pins 7, or 8 of the Cannon Connector). The standard type low pass output filter insert should provide a frequency intelligence response that is flat to within ±0.5 db from DC to the cutoff frequency of the particular unit.

Since the output amplifier consists of two sections, further localization of testing may be made by checking the output of the first section at the 100K cathode resistor R-418 of V-402B located on the component card opposite V-402. With a standard insert the attenuation characteristics in db should be about one-half those of the complete amplifier output.

A ±1 volt signal into the zero offset input on Pin 19 of the Cannon connector should produce about ±1.5 volt output signal with SW-401 in Position #1 and R-447 full counter clockwise.

The second section of the amplifier can be isolated by pushing in the amplifier balance adjustment control on the front panel. This returns the output to this section at R-1419 to ground by SW-402. Turning this same control when pushed in will vary the balance voltage input to this section by R-450, thus varying the output approximately 60% of full range, not necessarily symetrically about center.

g. ZERO SIGNAL CIRCUIT

The operation of this circuit may be checked by alternately applying and removing the input subcarrier signal to the discriminator. If the circuit is operating properly and R-323 has been correctly adjusted, the output of the discriminator will be zero with no input signal.

h. POWER SUPPLY

The B+ and B- power supply voltages may be observed at terminals 18 and 17 located on the bandpass input filter card on the bottom of the discriminator chassis or on Pins 16 or 17 of the Cannon connector. With zero signal input to the discriminator, these voltages should be between 190 and 210 volts. The AC ripple voltage on either supply as measured with an RMS Voltmeter should be less than 4 millivolts. If the ripple voltage exceeds this figure on either supply, V-4 or V-6 should be changed.

The regulation of the regulated filament windings should be within ±1% and ±0.5% for a 105 to 125 volt 60 cps input range as noted on the circuit schematic D-01999.

The grid bias supply for V-404 and V-405 should be about -90 volts with respect to B- at the junction of R-438 and D-402. About 0.2 volts rms of ripple should be observable at this point.

4. REPAIRS

The techniques for repairing the Model 67 ( ) subcarrier discriminator are similar to those employed with other electronic equipment. When a unit is not operating properly, the procedure outlined under Inspection and Performance Tests will usually serve to localize the difficulty. The circuit wiring conforms to the color code listed in Table I.

TABLE I

BLACK	GND
WH. BLACK	B-
BROWN - BLACK	UNREGULATED FILAMENTS
BROWN - YELLOW	REGULATED FIL. ±1%
BROWN - ORANGE	REGULATED FIL. ±1/2%
BROWN - BLUE	UNREGULATED FILAMENTS
RED	B+
BLUE	PLATES
SLATE	CATHODES
ORANGE	SCREENS
GREEN	GRIDS
WH. - RED	H. V. AC
WH. - RED - BLUE	AMP. BAL. RETURN
WH. - RED - YELLOW	AMP. BALANCE

NOTE: All output leads shielded to Cannon connector. All input leads shielded from Cannon connector to cards. Input level shielded from Cannon connector to card.

SECTION VII
TABLES AND DRAWINGS

1. Tube Socket Voltages

2. Block Diagram and Waveforms at Selected Socket Lugs . . 67D . . . . . Drawing B-00976
   67F . . . . . Drawing B-01879

3. Block Diagram, Components Location (Top) . . . . . Drawing B-00977

4. Block Diagram, Components Location (Bottom) . . . . . Drawing B-01241

5. Bandpass Input Filter Characteristic Attenuation Curve . . . . . Drawing B-01875

6. Methods of Externally Controlling Output Amplifier Gain . . . . . Drawing B-01983

7. Discriminator Replaceable Parts

8. Channel Selector Unit Replaceable Parts

9. Low Pass Filter Insert Unit Replaceable Parts

10. Discriminator Tuning Capacitor (C-1306) Values

11. Cannon Connector Pin Functions . . . . . Drawing A-04452

12. Subcarrier Discriminator Circuit Diagram 67D . . . . . Drawing D-01999

13. Subcarrier Discriminator Circuit Diagram 67F . . . . . Drawing D-02001

TUBE SOCKET VOLTAGES MODEL 67 DISCRIMINATOR

Typical D-C Volts at Socket Pins with 115 Volts AC Input

TUBE	1	2	3	4	5	6	7	8	9
V-1	0	350	0	-1.8	0	-1	0	350	
V-2	0	117	0	-195	0	-195	0	115	
V-3	150	350	200	-22	90	0	0	0	
V-4	-110	-111	-4	-100	-100	0	-4	110	142
V-5	-111	-200		-200	-111		-200		
V-6	-110	-111	-88	-100	-100	-85	-88	-60	-22
V-101	200	89	90	0	0	200	89	90	0
V-102	200	90	91	0	0	200	0	2.5	0
V-103	130	0	2.7	-100	-100	-6.5	-183	-185	-100
V-201	-2.6	0	0	0	100	200	0		
V-202	25	-17	0	0	4.4	0	4.4		
V-203	100	135	0	0	2.5	9	22.5		
V-301	-195	-165	-100	-100	-40	0	-165		
V-302	-183	-174	-100	-100	-40	-61	-174		
V-303	-40	-40	0	0	0	195	0	0	0
V-304	--	-195	-100	-100	-62	-140	-195		
V-305	-70	-12	0	0	0	200	-12		
V-401	55	-0.8	0	0	0	90	-1	0	0
V-402	200	-1.8	100	0	0	110	0	-0.8	-8
V-403	0	-1.5	130	0	0	0	-1.7	55	100
V-404	-200	-195	-200	-200	-15	-26	-195		
V-405	-195	-200	-40	-200	-200	0	-195	-40	-200
V-406	0	0	200	200	-15	0	0	0	

AC Volts at Selected Socket Lugs (RMS)

V-1				310		310			
V-2				375		375			
V-103						26			

NOTES:

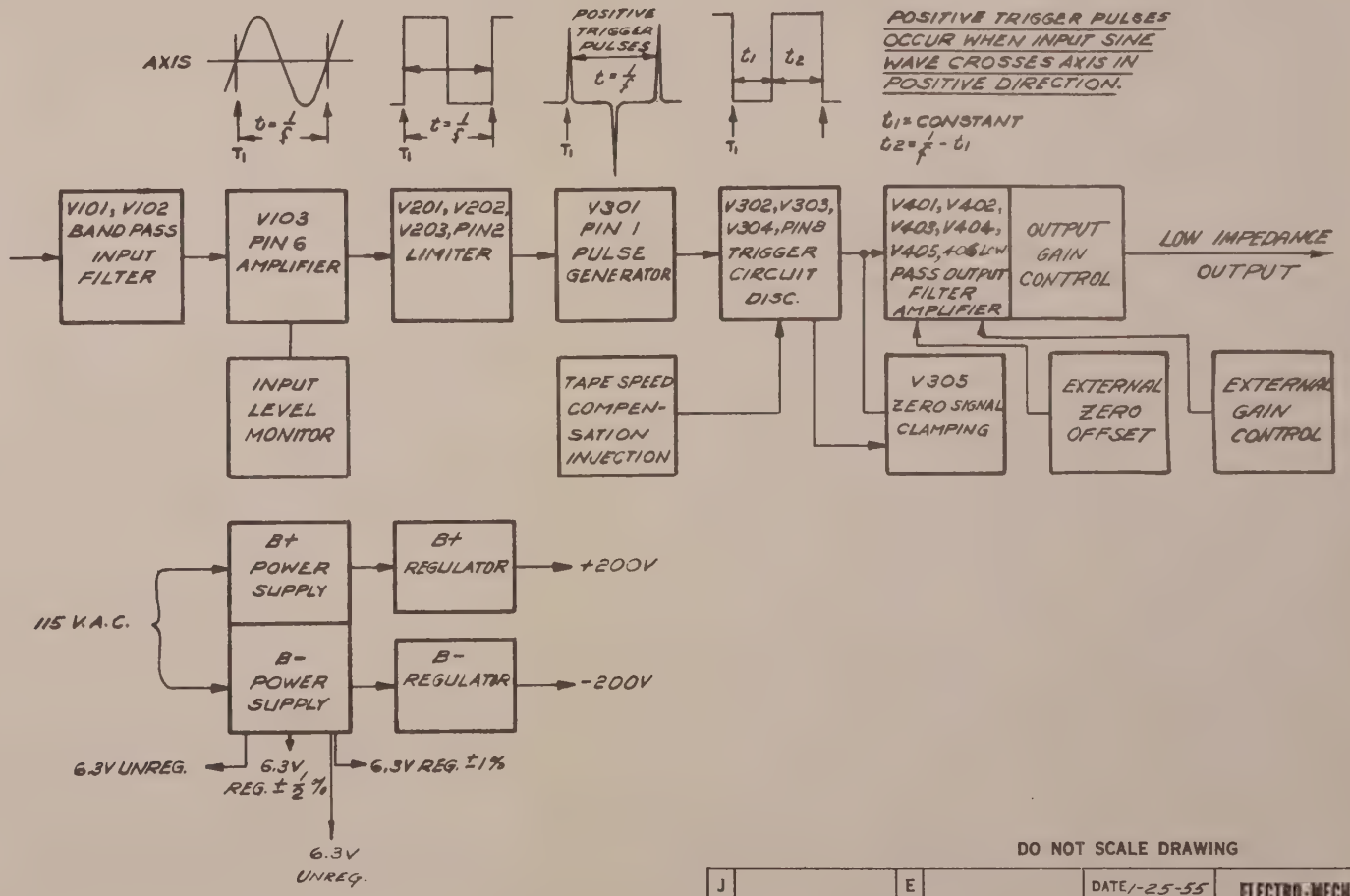
1. Voltages should be measured with equipment in normal operation with input level meter at center scale (50), and output centered to zero volts with the output gain at lowest value (±6). No output

load. Operation below 3.9 Kc is preferable to avoid stray effects due to the measuring probe. Input line voltage should be 115 volts RMS at 60 cps.

2. Vacuum tube voltmeters should be used for both a-c and d-c measurements. All readings are made from the point indicated to chassis ground.

3. Design center value are indicated throughout and are subject to normal variations resulting from tube and component tolerances.

4. All heaters 6.3 volts A.C. except V-1 and V-2 which are 5.0 volts A.C.



DO NOT SCALE DRAWING

J		E		DATE 1-25-55	ELECTRO-MECHANICAL RESEARCH INC. RIDGEFIELD, CONNECTICUT		
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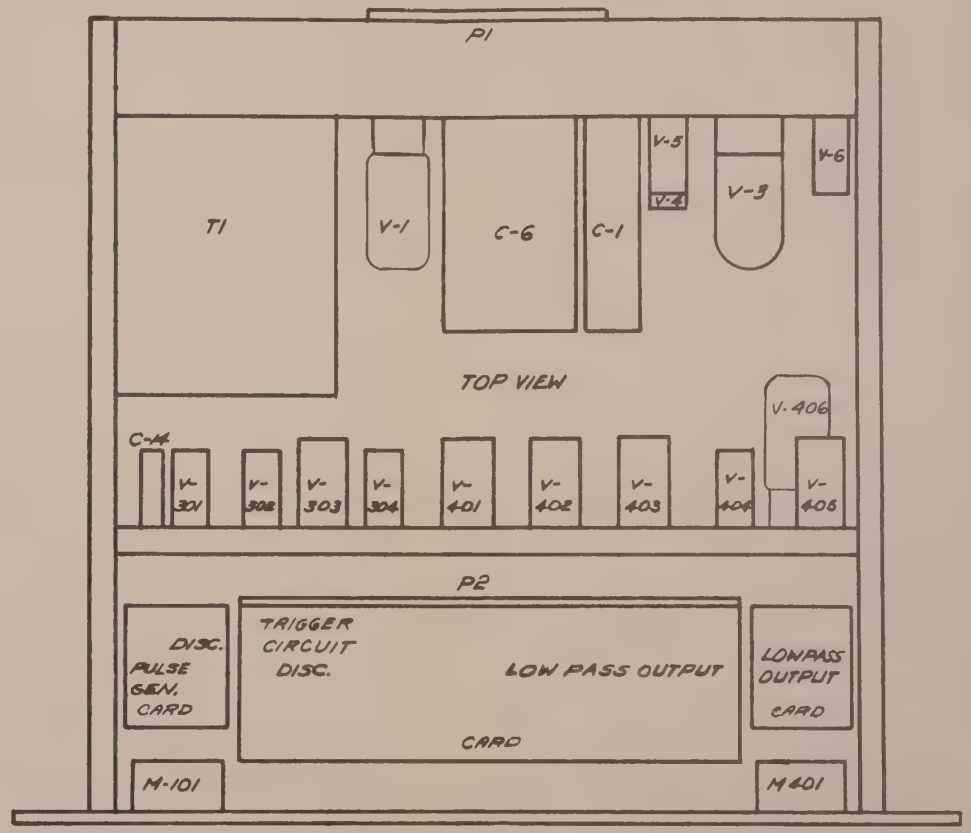
H		C		DRAWN F.P	MAT'L.	TOL. UNLESS NOTED	
G		B	GAIN CONTROLS & ZERO OFFSET ADDED 10-28-55	CKD.	FINISH	FRACTIONAL ± 1/64	
F		A	DELETED OUTPUT ATTEN. 8-22-55	APP. W.H.Q		DECIMAL ± .005	
REVISIONS				NO. REQ'D.	BLOCK & WAVEFORM DIAGRAM		
					670-B1		

(A) (B)

B-00976



V-1 - 5V4 GA
V-3 - 6080
V-4 - 5651 WA
V-5 - 6AW8A
V-6 - 6AW8A
V-301 - 6AU6
V-302 - 6AU6
V-303 - 6201
V-303 - 6136
V-401 - 12AY7
V-402 - 6U8
V-403 - 6AW8A
V-404 - 6AU6
V-405 - 6197
V-406 - 6L6GB

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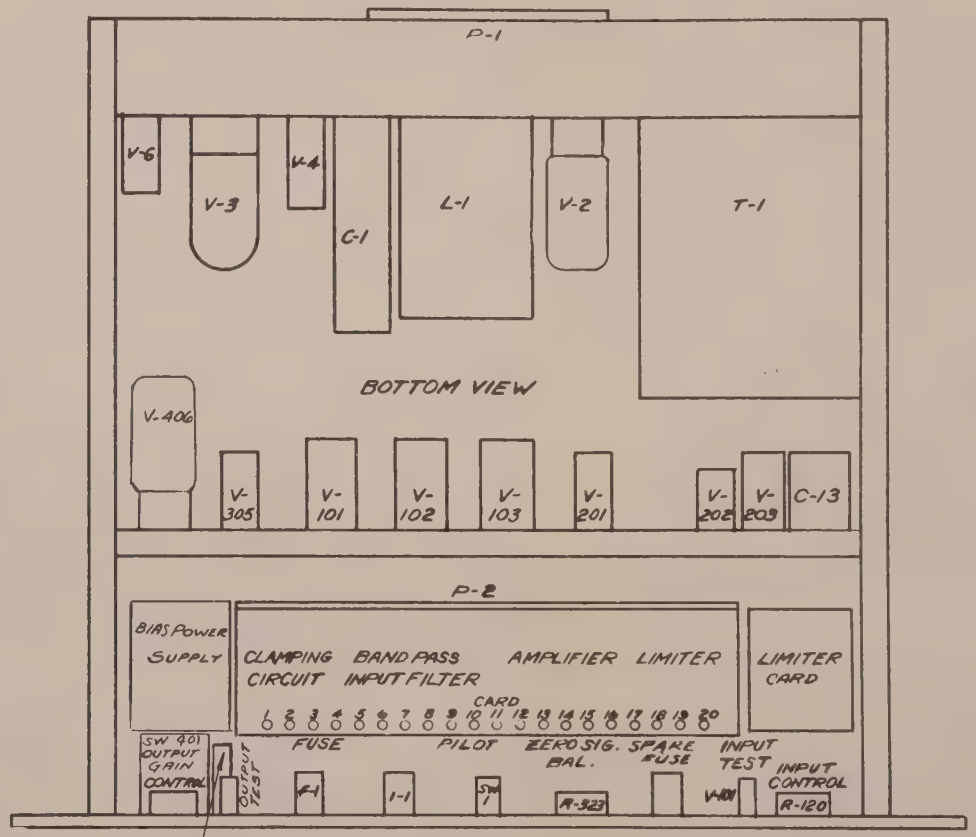
H		C		DRAWN F.P.	MAT'L. / TOL. UNLESS NOTED FRACTIONAL ± 1/64
G		B		CKD.	FINISH / DECIMAL ± .005
F		A		APP.	LOCATION OF COMPONENTS
REVISIONS				NO. REQ'D.	670-B2

B-00977



V-2 - 5V4GA
V-3 - 6080
V-4 - 6AW8A
V-6 - 6AW8A
V-101 - 12AT7
V-102 - 12AT7
V-103 - 12AY7
V-201 - 6AU6
V-202 - 6AL5
V-203 - 5964
V-305 - 6AU6
V-406 - 6L6GB

DO NOT SCALE DRAWING

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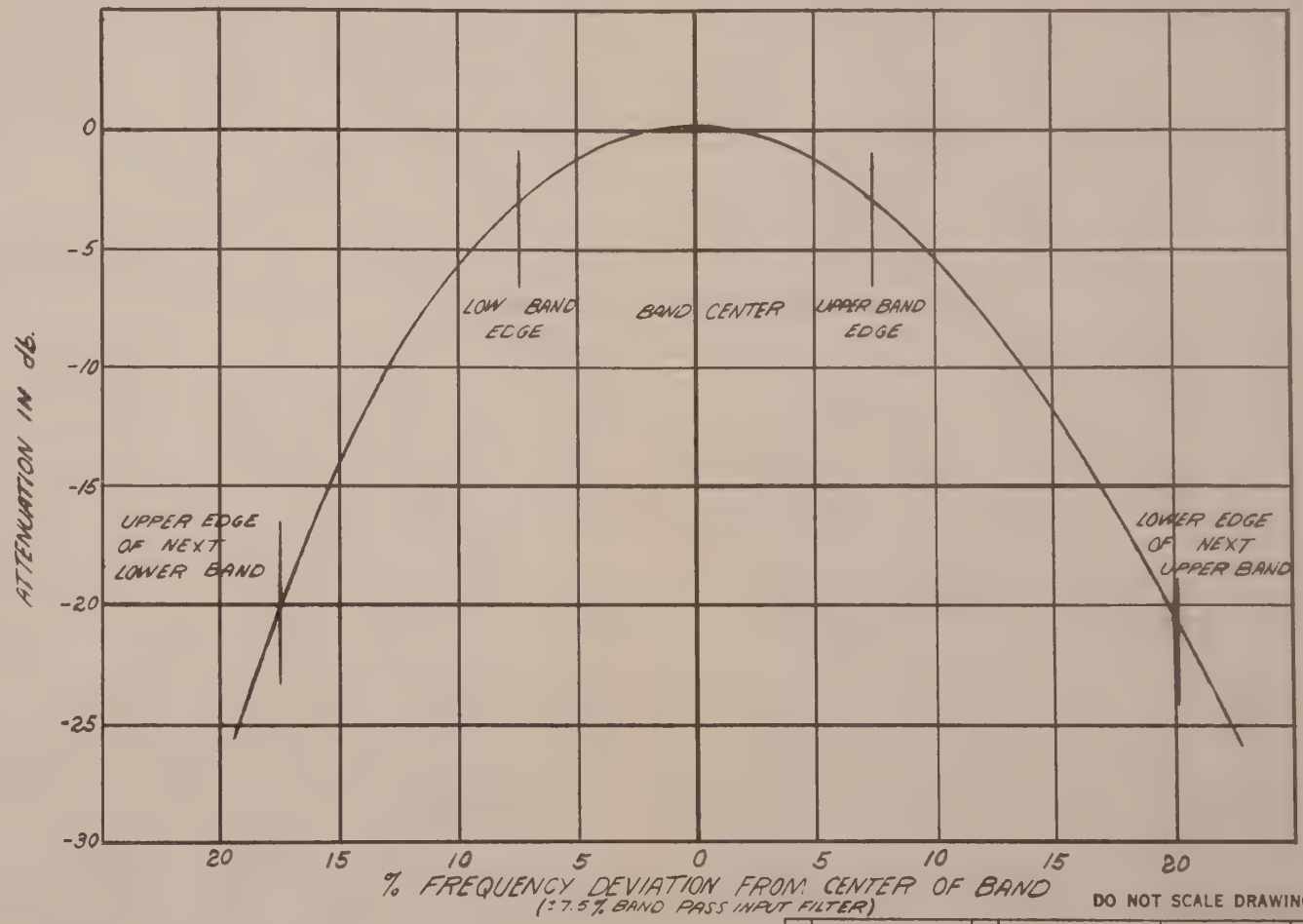
G		B		CKD.	FINISH	FRACTIONAL ± 1/64
F		A		APP. WA	LOCATION OF COMPONENTS	DECIMAL ± .003
REVISIONS				NO. REQ'D.	670-B3	

B-01241



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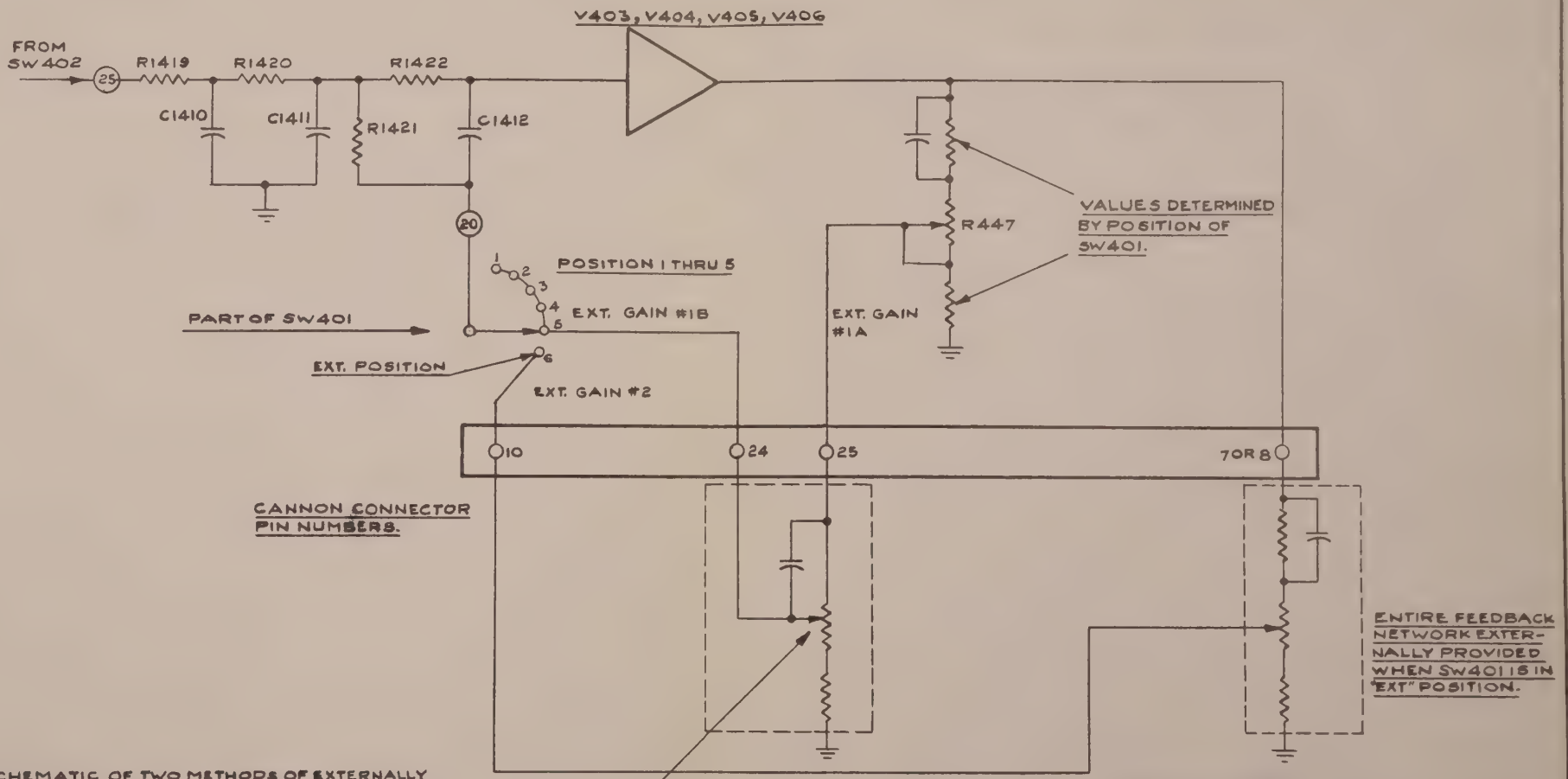
J		E		DATE 2-10-55	ELECTRO-MECHANICAL RESEARCH INC. RIDGEFIELD, CONNECTICUT
I		D		SCALE ~	
H		C		DRAWN A.P.B.	MAT'L. —— TOL. UNLESS NOTED
G		B		CKD.	FINISH —— FRACTIONAL ± 1/64 DECIMAL ± .005
F		A		APP. W.H.S.	TYPICAL BAND PASS INPUT FILTER ATTENUATION
REVISIONS				NO. REQ'D.	67 -C6

B-01875



SCHEMATIC OF TWO METHODS OF EXTERNALLY VARYING THE GAIN OF THE OUTPUT AMPLIFIER OF MODEL 67D-E-F.

DO NOT SCALE DRAWING

J		E		DATE 1-16-56	ELECTRO-MECHANICAL RESEARCH INC. RIDGEFIELD, CONNECTICUT
I		D		SCALE	
H		C		DRAWN F.F.	MAT'L.
G		B		CKD.	FINISH
F		A		APP.	SCHEM. FOR VARYING GAIN EXTER. MODELS 67D-E-F
REVISIONS				NO. REQ'D.	B-01983

TOL. UNLESS NOTED
FRACTIONAL ± 1/64
DECIMAL ± .005

Eugene Dietzgen Co., Inc., New York, N. Y. No. 1964 Agaproof Tracing Vellum

Model 67 Discriminator Replaceable Parts

Symbol	Description	Manufacturer	Type and Tolerance		Function
R-1	100 Ohms	Dale	B-25	10%	A-C Ripple Filter
R-2	330 K	Electra	DC-1/2c	1%	B+ Supply 1st Amp. Plate Load
R-3	6485 Ohms	Dale	RS-5	1%	B+ Supply 1st Amp. Cathode Bias Divider
R-4	25 K	Dale	RS-10	1%	B+ Supply 1st Amp. Cathode Bias Divider
R-4A	820 K	Allen-Bradley	EB	10%	R-4 Shunt Resistor
R-5	5.6 K	Allen-Bradley	EB	10%	B+ Regulator Stabilizing Network
R-6	270 K	Allen-Bradley	EB	10%	B+ Supply 2nd Amp. Plate Load
R-7	39 K	IRC	MDC	1%	B+ Supply 2nd Amp. Screen Ripple Bridge
R-8	150 K	IRC	MDC	1%	B+ Supply 2nd Amp. Screen Ripple Bridge
R-9	82K	IRC	MDC	1%	B+ Supply 2nd Amp. Screen Ripple Bridge
R-10	1.0 Megohm	Allen-Bradley	EB	10%	B+ Supply 1st Amp. Grid Isolation
R-11	47 K	Allen-Bradley	EB	10%	Reference Tube Current Limiting
R-12	10 K	Allen-Bradley	EB	10%	B- Supply 1st Amp. Grid Isolation
R-13	8 K	Dale	RS-5	1%	B- Supply 1st Amp. Cathode Bias
R-14	5895 Ohms	Dale	RS-5	1%	B- Supply 1st Amp. Cathode Bias
R-15	820 K	Electra	DC-1/2c	1%	B- Supply 1st Amp. Plate Load
R-16	470 K	Allen-Bradley	EB	10%	B- Supply 2nd Amp. Plate Decoupling
R-17	5.6 K	Allen-Bradley	EB	10%	B- Supply Regulator Stabilizing Network
R-18	220 K	Allen-Bradley	EB	10%	B- Supply 2nd Amp. Plate Load
R-19	10 K	Dale	RS-5	1%	B- Supply 2nd Amp. Cathode Bias Divider
R-20	8 K	Dale	RS-5	1%	B- Supply 2nd Amp. Cathode Bias Divider
R-21	38.1 K	Electra	DC-1	1%	B- Supply 2nd Amp. Screen Ripple Bridge
R-22	4.1 K	Electra	DC-1/2c	1%	B- Supply 2nd Amp. Screen Ripple Bridge
R-23	47 K	IRC	MDC	1%	B- Supply 2nd Amp. Screen Ripple Bridge
R-24	26.5 K	Electra	DC-1	1%	B- Supply 2nd Amp. Screen Ripple Bridge
R-25	120 K	IRC	MDC	1%	Heater DC Voltage Reference Divider
R-26	100 K	IRC	MDC	1%	Heater DC Voltage Reference Divider
R-27	68 Ohms	Allen-Bradley	EB	10%	B+ Supply Parasitic Suppressor
R-28	68 Ohms	Allen-Bradley	EB	10%	B- Supply Parasitic Suppressor
R-29	18 K	Allen-Bradley	EB	10%	B+ Supply 2nd Amp. Screen Ripple Bridge
R-30	5.5 K	Sage	S5W	3%	B+ Regulator Shunt
R-31	5.5 K	Sage	S5W	3%	B- Regulator Shunt
R-101	1. Megohm	Allen-Bradley	EB	10%	1st Filter-Amp. Grid Return
R-102	270 Ohms	Allen-Bradley	EB	10%	1st Filter-Amp. Cathode Voltage Divider

Symbol	Description	Manufacturer	Type and Tolerance		Function
R-103	27 K	Allen-Bradley	EB	10%	1st Filter-Amp. Cathode Voltage Divider
R-1104	See Channel Selector Parts List				
R-105	27 K	Allen-Bradley	EB	10%	2nd Filter-Amp. Cathode Bias
R-1106	See Channel Selector Parts List				
R-107	27 K	Allen-Bradley	EB	10%	3rd Filter-Amp. Cathode Bias
R-1108	See Channel Selector Parts List				
R-109	39 K	Allen-Bradley	HB	10%	4th Filter-Amp. Cathode Bias
R-1110	See Channel Selector Parts List				
R-111	3.9 K	Allen-Bradley	EB	10%	1st Amplifier Cathode Bias
R-112	100 K	Allen-Bradley	EB	10%	1st Amplifier Plate Load
R-113	100 K	Allen-Bradley	EB	10%	1st Amplifier Plate Cathode Feedback
R-114	1.0 Megohm	Allen-Bradley	EB	10%	2nd Amplifier Grid Return
R-115	68 K	Allen-Bradley	EB	10%	2nd Amplifier Plate Load
R-116	820 Ohms	Allen-Bradley	EB	10%	2nd Amplifier Cathode Bias
R-117	3.3 K	Allen-Bradley	EB	10%	Input Level Meter Bridge
R-118	3.3 K	Allen-Bradley	EB	10%	Input Level Meter Bridge
R-119	Not used				
R-120	500 K	Ohmite	CA-5041		Input Level Control
R-121	68 Ohms	Allen-Bradley	EB	10%	Band Pass Filter Parasitic Suppressor
R-122	68 Ohms	Allen-Bradley	EB	10%	Band Pass Filter Parasitic Suppressor
R-123	68 Ohms	Allen-Bradley	EB	10%	Band Pass Filter Parasitic Suppressor
R-124	68 Ohms	Allen-Bradley	EB	10%	Band Pass Filter Parasitic Suppressor
R-1125	*	Electra	DC-1/2c	1%	Band Pass Filter Gain Adjust
R-1126	*	Allen-Bradley	EB	10%	Band Pass Filter Gain Adjust
R-201	47 K	Allen-Bradley	EB	10%	Limiter Input Isolation
R-202	1 Megohm	Allen-Bradley	EB	10%	Limiter Input Grid Isolation
R-203	1.2 Megohm	Electra	DC-1/2A	1%	Limiter Plate-Grid Divider
R-204	2.2 Megohm	Electra	DC-1/2A	1%	Limiter Plate-Grid Divider
R-205	12 K	Allen-Bradley	HB	10%	Limiter Plate Load
R-206	18 K	IRC	MDC	1%	1st Limiter-Diode Cathode Bias Divider
R-207	180 K	IRC	MDC	1%	1st Limiter-Diode Cathode Bias Divider
R-208	1 Megohm	Allen-Bradley	EB	10%	2nd Limiter-Diodes D.C. Return
R-209	18 K	IRC	MDC	1%	2nd Limiter-Diodes Plate Bias Divider
R-210	180 K	IRC	MDC	1%	2nd Limiter-Diodes Plate Bias Divider
R-211	65 K	IRC	MDC	1%	Trigger Input Grid Bias Divider

*Used on 7.5% units only, Value Factory Adjusted.

Symbol	Description	Manufacturer	Type and Tolerance		Function
R-212	164 K	IRC	MDC	1%	Trigger Input Grid Bias Divider
R-213	47 K	Electra	DC-1	1%	1st Section Trigger Plate Load
R-214	18 K	Electra	DC-1	1%	2nd Section Trigger Plate Load
R-215	3.9 K	IRC	MDC	1%	Trigger Cathode Bias
R-216	330 K	Electra	DC-1/2c	1%	Trigger Plate-Grid Coupling
R-217	100 K	IRC	MDC	1%	2nd Section Trigger Grid Bias Divider
R-218	1.5 Megohms	Electra	DC-1/2A	1%	2nd Section Trigger Grid Bias Divider
R-301	120 K	Allen-Bradley	EB	10%	Pulse Generator Grid Return
R-302	8.2 K	Allen-Bradley	EB	10%	Pulse Generator Cathode Divider
R-303	120 K	Allen-Bradley	EB	10%	Pulse Generator Cathode Divider
R-304	22 K	Allen-Bradley	HB	10%	Discriminator Cathode Divider
R-305	1.2 K	Allen-Bradley	GB	10%	Discriminator Cathode Divider
R-306	18 K	Allen-Bradley	GB	10%	Discriminator Screen Voltage Dropping
R-307	40 K	Mepco	P-15	1%	Discriminator Plate Load
R-308	100 K	Allen-Bradley	EB	10%	Discriminator Grid Return
R-309	470 K	Allen-Bradley	EB	10%	Discriminator Plate to Grid Coupling
R-310	150 K	Eastern Prec. Res.	NS-6ALOC	1%	Cathode Bias Divider
R-311	150 K	Eastern Prec. Res.	NS-6ALOC	1%	Cathode Bias Divider
R-312	30 K	Mepco	P-15	3%	Discriminator Output Cathode Bias
R-313	47 K	Allen-Bradley	GB	10%	Discriminator Screen Dropping
R-1314	See Channel Selector Parts List				
R-315	120 K	Allen-Bradley	HB	10%	Plate Load
R-316	75 K	Electra	DC-1	1%	Clamper Cathode Divider
R-317	820 K	Electra	DC - 1/2c	1%	Clamper Screen Voltage Dropping
R-318	1.2 Meg	Allen-Bradley	EB	10%	Clamper Grid Isolation
R-319	1.2 K	Allen-Bradley	EB	10%	Discriminator Plate Isolation
R-320	Not Used				
R-321	Not Used				
R-1322	See Channel Selector Parts List				
R-323	20 K	Clarostat	49		Zero Signal Central Control
R-324	68 Ohms	Allen-Bradley	EB	10%	Discriminator Parasitic Suppressor

Symbol	Description	Manufacturer	Type & Tolerance		Function
R-1401	See Channel Selector Insert Parts List				
R-1402	See Low Pass Filter Insert Parts List				
R-1403	See Low Pass Filter Insert Parts List				
R-1404	See Low Pass Filter Insert Parts List				
R-405	220 K	Allen-Bradley	EB	10%	1st Output Amp. Stage Plate Load
R-406	680 Ohms	Allen-Bradley	EB	10%	1st Output Amp. Stage Stabilizer Network
R-407	1.0 Megohm	Allen-Bradley	EB	10%	Output Amp. Stage Plate-Grid Coupling
R-408	64 K	IRC	MDC	1%	Output Meter Series Load
R-409	3.3 Megohms	Allen-Bradley	EB	10%	2nd Output Amp. Stage Grid Divider
R-410	330 Ohms	Allen-Bradley	EB	10%	2nd Output Amp. Stage Stabilizer Network
R-411	1.0 Megohms	Allen-Bradley	EB	10%	2nd Output Amp. Stage Plate-Grid Coupling Divider
R-412	2.2 Megohms	Allen-Bradley	EB	10%	3rd Output Amp. Stage Grid Divider
R-413	22 K	Allen-Bradley	GB	10%	3rd Output Amp. Stage Plate Load
R-414	18 K	Allen-Bradley	GB	10%	3rd Output Amp. Stage Screen Divider
R-415	22 K	Allen-Bradley	GB	10%	3rd Output Amp. Stage Screen Divider
R-416	820 K	Allen-Bradley	EB	10%	3rd Output Amp. Stage Plate-Grid Coupling Divider
R-417	1.2 Megohms	Allen-Bradley	EB	10%	4th Output Amp. Stage Grid Return
R-418	100 K	Allen-Bradley	GB	10%	4th Output Amp. Stage Cathode Bias
R-1419	See Low Pass Filter Insert Parts List				
R-1420	See Low Pass Filter Insert Parts List				
R-1421	See Low Pass Filter Insert Parts List				
R-1422	See Low Pass Filter Insert Parts List				
R-423	100 K	Allen-Bradley	EB	10%	5th Output Amp. Stage Plate Load
R-424	1.8 K	Allen-Bradley	EB	10%	5th Output Amp. Stage Stabilizer Network
R-425	1.2 Megohms	Electra	DC 1/2A	1%	5th Output Amp. Stage Plate-Grid Coupling Divider
R-426	1.65 Megohms	Electra	DC 1/2C	1%	6th Output Amp. Stage Grid Divider
R-427	390 K	Electra	DC 1/2C	1%	6th Output Amp. Stage Grid Divider
R-428	27 K	Allen-Bradley	GB	10%	6th Output Amp. Stage Plate Load
R-429	3.3 K	Allen-Bradley	EB	10%	6th Output Amp. Stage Stabilizer Network
R-430	4.7 K	Allen-Bradley	HB	10%	8th Output Amp. Stage Screen Dropping
R-431	3.3 K	Sage	S5W	3%	Output Attenuator Element, 6.6-15v Position
R-432	1 Meg	Electra	DC 1/2C	1%	6th Output Amp. Stage Voltage Divider
R-433A	120 K	Allen-Bradley	HB	10%	7th Output Amp. Stage Plate Load
R-433B	100 K	Allen-Bradley	HB	10%	7th Output Amp. Stage Plate Load
R-434	68 Ohms	Allen-Bradley	EB	10%	Cathode Follower Output Amp. Parasitic Suppressor
R-435	18 K	Allen-Bradley	GB	10%	7th Output Amp. Stage Screen Dropping

Symbol	Description	Manufacturer	Type and Tolerance		Function
R-436	180 K	Allen-Bradley	EB	10%	B- Power Supply Bleeder
R-437	220 K	Allen-Bradley	EB	10%	AC Ripple Filter
R-438	82 K	Allen-Bradley	EB	10%	AC Ripple Filter
R-1438	See Low Pass Filter Insert Parts List				
R-439	8.2 K	Ohmite	3W	3%	Output Attenuator Element 15-20v Position
R-440	15 K	Precision Res. Co.	SX1816	2%	Output Attenuator Element 20-30v Position
R-1441	See Low Pass Filter Insert Parts List				
R-442	100 K	Allen-Bradley	EB	10%	2nd Output Amp. Plate Load
R-1443	See Channel Selector Parts List				
R-444	33 Ohms	Allen-Bradley	EB	10%	B- De-coupling Resistor
R-445	3.1 K	Ohmite	3W	3%	Output Filter Feedback Divider
R-446	3.3 K	IRC	MDC	1%	Output Filter Feedback Divider
R-447	5. K	Centralab			Output Attenuator for Fine Control
R-448	2.7 K	IRC	MDC	1%	Amplifier Balance Divider Element
R-449	150 K	Electra	DC-1/2c	1%	Amplifier Balance Divider Element
R-450	5 K	Clarostat	49		Output Amplifier Balance Control
R-451	27 K	Precision Res. Co.	SX-1510	2%	Output Attenuator Element 30-50v. Position
R-452	47 K	IRC	MDC	1%	Output Attenuator Element 50-90v. Position
R-453	10 K	Allen-Bradley	EB	10%	Output Amplifier Grid Resistor
R-454	3.5 Meg	Electra	DC-1/2c	1%	6th Output Amp. Stage Voltage Divider
R-455	22 K	Allen-Bradley	HB	10%	6th Output Amp. Stage Screen Divider
R-456	10 K	Allen-Bradley	GB	10%	6th Output Amp. Stage Screen Divider
R-469	390 K	Electra	DC-1/2c	1%	Voltage Divider for Diode Limiter
R-470	6 K	Electra	DC-1/2c	1%	Voltage Divider for Diode Limiter
R-473	560 K	Allen Bradley	EB	10%	Zero Signal Light Current Limiter
R-474	560 K	Allen Bradley	EB	10%	Zero Signal Light Test Circuit
D-101	IN38A/IN58A	Sylvania			Input Meter Bridge Rectifier
D-102	IN38A/IN58A	Sylvania			Input Meter Bridge Rectifier
D-402	IN1998A	U.S. Semi Conductor Products	100v	±5%	Bias Power Supply Regulator
D-403	9GA20	Intern'l Res. Corp.			Bias Power Supply Rectifier

Symbol	Description	Manufacturer	Type and Tolerance	Working Voltage	Function
C-1	10.0 Mfd.	Sprague	CP70B1FF106V	600	Unregulated B+ Filter
C-2	.0005 Mfd.	El-Menco	CM-15E-501J 5%	300	B+ Supply 1st Amp. Grid Decoupling
C-3	1.0 Mfd.	Pyramid	7PGIHL4-1	400	B+ Supply 1st Amp. Cathode Coupling
C-4	.001 Mfd.	El-Menco	CM19B-102K 10%	500	B+ Supply Regulator Stabilizer Network
C-5	6.0 Mfd.	Sprague	CP70B1FF605V	600	Unregulated B- Filter
C-6	.01 Mfd.	El-Menco	CM35B-103K 5%	500	B- Supply 1st Amp. Grid Decoupling
C-7	.5 Mfd.	Sprague	CP54-B1-EE-504M	400	B- Supply 1st Amp. Cathode Coupling
C-8	.001 Mfd.	El-Menco	CM19B-102K 10%	500	B- Supply Regulator Stabilizer Network
C-9	.01 Mfd.	El-Menco	CM35B-103K 10%	500	B- Supply 2nd Amp. Plate Decoupling
C-10	.47 Mfd.	Pyramid	7PGH	300	B- Supply 2nd Amp. Cathode Bypass
C-11	.22 Mfd.	Pyramid	PGH	200	B- Supply Screen Bridge Network
C-12	.22 Mfd.	Pyramid	PGIH	200	B- Supply 2nd Amp. Cathode Bypass
C-13	1.0 Mfd.	Tobe	OMB-401 20%	400	Regulated B+ Supply Filter
C-14	2.0 Mfd.	Tobe	OMB-402 20%	400	Regulated B- Supply Filter
C-15	4.0 Mfd.	Cornell-Dubilier	KC3040-15	300 AC	Power Transformer Primary Tuning Part of T-1 for Model D only
C-16	.01 Mfd.	El-Menco	CM35B-103K 10%	500	Regulated Filaments Bypass
C-17	.039 Mfd.	Pyramid	PGH --	200	B+ Supply Screen Stabilizing Network
C-101	.01 Mfd.	El Menco	CM35B-103K 10%	500	Input Coupling
C-1102	See Channel Selector Parts List				
C-103	.22 Mfd.	Pyramid	7EPGIH 20%	300	Coupling to Monitor Circuits
C-1104	See Channel Selector Parts List				
C-1105	See Channel Selector Parts List				
C-1106	See Channel Selector Parts List				
C-107	.01 Mfd.	El-Menco	CM35B-103K 10%	500	1st Amp. Plate-Grid Coupling
C-108	20 Mmf.	El-Menco	CM15C-200J 5%	500	Input Potentiometer Capacity Compensation
C-201	.22 Mfd.	Pyramid	EPGIH 20%	200	2nd Amp. Output Coupling
C-202	.05 Mfd.	Pyramid	EPGIH 20%	200	Limiter Input Coupling
C-203	.05 Mfd.	Pyramid	EPGH 20%	200	Limiter Grid Divider Decoupling
C-204	.1 Mfd.	Pyramid	EPGIH 20%	300	Limiter Grid-Diode Plate Cathode Coupling
C-205	.00015 Mfd.	El-Menco	CM15E-151J 5%	500	Limiter Diode Positive Peak Coupling
C-206	.00015 Mfd.	El-Menco	CM15E-151J 5%	500	Limiter Diode Negative Peak Coupling
C-207	24. Mmf.	El-Menco	CM15E-240J 5%	500	Trigger Input Grid Coupling
C-208	30. Mmf.	El-Menco	CM15E-300J 5%	500	Trigger Plate-Grid Coupling
C-209	10. Mmf.	El-Menco	CM15C-100J 5%	500	Pulse Generator Grid Coupling

Symbol	Description	Manufacturer	Type and Tolerance	Working Voltage	Function
C-301	.002 Mfd.	El-Menco	CM20B-202K 10%	500	Pulse Generator Cathode Bypass
C-302	.12 Mfd.	Pyramid	7PGIH 20%	300	Discriminator Screen Bypass
C-303	3. Mmf.	El-Menco	CM15E-030M 20%	300	Discriminator Feedback
C-304	Not Used				
C-305	.022 Mfd.	Pyramid	PGIHV 20%	300	V-304 Screen Bypass
C-1306	See Channel Selector Parts List				
C-307	.1 Mfd.	Pyramid	7PGIM 20%	600	Frequency Output Plate Decoupling
C-1401	See Low Pass Filter Insert Parts List				
C-1402	See Low Pass Filter Insert Parts List				
C-1403	See Low Pass Filter Insert Parts List				
C-404	.05 Mfd.	Pyramid	EPGIH 20%	300	1st Output Amp. Stage Stabilizer Network
C-405	.00015 Mfd.	El-Menco	CM15E-151J 5%	500	1st Output Amp. Stage Plate Grid Coupling
C-406	.00068 Mfd.	El-Menco	CM19B-681K 10%	500	2nd Output Amp. Stage Stabilizer Network
C-407	30. Mmf.	El-Menco	CM15E-300J 5%	500	2nd Output Amp. Stage Plate-Grid Coupling
C-408	.002 Mfd.	El-Menco	CM20B-202K 10%	500	3rd Output Amp. Screen Stage Decoupling
C-409	20. Mmf.	El-Menco	CM15C-200J 5%	500	3rd Output Amp. Stage Plate-Grid Coupling
C-1410	See Low Pass Filter Insert Parts List				
C-1411	See Low Pass Filter Insert Parts List				
C-1412	See Low Pass Filter Insert Parts List				
C-413	.0039 Mfd.	El-Menco	CM30-B-392-K 10%	300	5th Output Amp. Stage Stabilizer Network
C-415	.003 Mfd.	El-Menco	CM30B-302K 10%	500	6th Output Amp. Stage Grid Return Divider Decoupling
C-416	.001 Mfd.	El-Menco	CM19B-102-K 10%	300	6th Output Amp. Stage Stabilizer Network
C-417	680 MMfd.	El-Menco	CM19B-681-K 10%	600	6th Output Amp. Stage Plate-Grid Coupling
C-418	.1 Mfd.	Pyramid	7PGIM 20%	600	Bias Power Supply AC Coupling
C-419	.002 Mfd.	El-Menco	CM20B-202K 10%	500	7th Output Amp. Stage Screen Decoupling
C-420	.47 Mfd.	Pyramid	7PG1H 20%	200	B- Power Supply Filter
C-421	.25 Mfd.	Pyramid	7EPGH 20%	300	Negative Supply Decoupling
C-422	20 Mmf.	El-Menco	CM15C-200J 5%	500	Output Amp. Feedback Condenser
C-423	.05 Mfd.	Pyramid	EPG1H 20%	300	Output Amp. Stage Screen Decoupling
C-424	910 Mmf.	El-Menco	CM19B-911K 10%	500	Output Gain Switch Stabilizer
C-425	360 Mmf.	El-Menco	CM19B-361K 10%	500	Output Gain Switch Stabilizer
C-426	200 Mmf.	El-Menco	CM19B-201K 10%	500	Output Gain Switch Stabilizer
C-427	110 Mmf.	El-Menco	CM19B-111K 10%	500	Output Gain Switch Stabilizer
C-428	68 Mmf.	El-Menco	CM19B-680K 10%	500	Output Gain Switch Stabilizer

Symbol	Description	Manufacturer	Type	Function
F-1	Fuse	Littelfuse	313002	Line Fuse
F-2	Fuse	Littelfuse	313500 .5 Amp.	Regulated Line Fuse, 67F Model Only
I-1	Signal Light	Dialco	8-1930-121	On-Off Indicator
I-2	NE2D	Dialco or G.E.		Zero Signal Lamp
J-101	Jack	E.F. Johnson Co.	105-602-1	Input Test
J-401	Jack	E.F. Johnson	105-610-1	Output Test
L-1	12 Hy. Inductor	Colin Campbell Co.	L-1855	B- Ripple Filter
L-1101	See Channel Selector Parts List			
L-1102	See Channel Selector Parts List			
L-1103	See Channel Selector Parts List			
L-1104	See Channel Selector Parts List			
L-401	.001 H	Miller	4632	B- Decoupling Choke
M-101	Panel Meter	Marion Electric	HS-0.2 ma	Input Level Indicator
M-401	Panel Meter	Marion Electric	HS-0.1-0-0.1 ma	Output Level Indicator
P-1	Connector	Cannon Electric	DPD-D32C2-34P-1L	Chassis Connector
P-2	Connector	EMR	B-00040	Operating Channel Plug-in Receptacle
SW-1	DPDT Switch	A.H. & H	81024-F	Power On-Off Switch
SW-401	Attenuator	EMR	-------	Select Output Level and Condition
SW-402	P.B. Switch	Microswitch	2AC1	Output Amplifier Input Shorting
V-1	Full Wave Rectifier	Sylvania	5V4GA	B± Rectifier
V-2	Full Wave Rectifier	Sylvania	5V4GA	B- Rectifier
V-3	Power Amp. Twin Triode	RCA	6080	B± and B- Regulator
V-4	Triode-Pentode	Tung-Sol	6AW8	B± Regulation Amplifier
V-5	Glow Discharge Tube	Raytheon	5651WA	Voltage Reference
V-6	Triode-Pentode	Tung-Sol	6AW8	B- Regulation Amplifier
V-101	Twin-Triode Amp.	RCA	12AT7	1st and 2nd Filter Cathode Follower
V-102	Twin-Triode Amp.	RCA	12AT7	3rd and 4th Filter Cathode Follower
V-103	Twin-Triode Amp.	RCA	12AY7	Filtered Input Signal Amplifier
V-201	R.F. Amp. Pentode	RCA	6AU6	Limiter
V-202	Dual Diode	RCA	6AL5	Limiter Level Setting
V-203	Twin Triode	RCA	5964	Trigger
V-301	R. F. Amp. Pentode	RCA	6AU6	Pulse Generator
V-302	R. F. Amp. Pentode	RCA	6AU6	Discriminator
V-303	Twin Triode	GE	6201	Diode Clipper-Cathode Follower

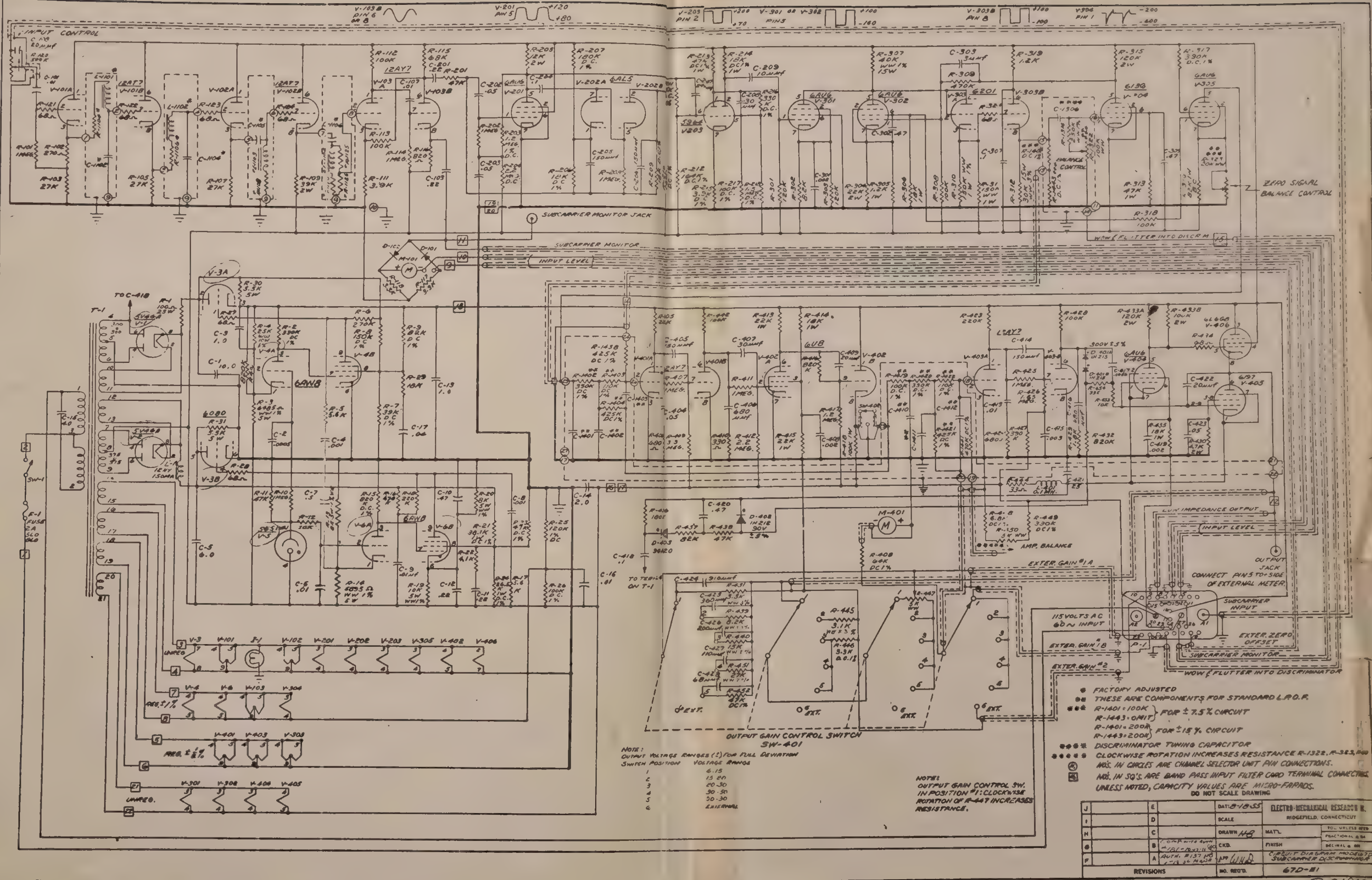
Symbol	Description	Manufacturer	Type	Function
V-304	R. F. Amp. Pentode	GE	6136	Discriminator
V-305	R. F. Amp. Pentode	RCA	6AU6	Output Clamping
V-401	Twin-Triode	RCA	12AY7	Output Filter Amplifier
V-402	Triode-Pentode	RCA	6U8	Output Filter Amplifier
V-403	Triode-Pentode	Tung-Sol	6AW8A	Output Filter Amplifier
V-404	R. F. Amp. Pentode	RCA	6AU6	Output Filter Amplifier
V-405	Beam Power Amp.	RCA	6197	Output Filter Amplifier
V-406	Beam Power Amp.	GE	6L6GB	Output Filter Cathode Follower
T-1	Power Transformer	Colin Campbell	L-2002	Power Transformer (Used on D Model Only)
T-1	Power Transformer	Colin Campbell	L-1926	Power Transformer (Used on F Model Only)

Description	Manufacturer	Type	Function
1/8" Bakelite Terminal Board	EMR	A-00066	Mounting Small Positive Supply Parts
1/8" Bakelite Terminal Board	EMR	A-00182	Mounting Small Negative Supply Parts
1/8" Bakelite Terminal Board	EMR	B-00046	Mounting Small Output Filter Parts
1/8" Bakelite Terminal Board	EMR	A-00178	Mounting Small Limiter Parts
1/8" Bakelite Terminal Board	EMR	A-00183	Mounting Small Discriminator and Pulse Generator Parts
1/8" Bakelite Terminal Board	EMR	B-00089	Mounting Small Bias Power Supply Parts
1/8" Bakelite Terminal Board	EMR	C-00064	Mounting Small Discriminator and Output Filter Parts
1/8" Bakelite Terminal Board	EMR	C-00062	Mounting Small Input Filter Parts
Octal Sockets	Cinch	16220	
7 Pin Sockets	Cinch	9355	
9 Pin Sockets	Cinch	13381	
7 Pin Tube Shield	Cinch	8690-1	
7 Pin Tube Shields	Cinch	8691-1	
9 Pin Tube Shields	Cinch	12628	
9 Pin Tube Shields	Cinch	13376	
7 Pin Shield	Intern'l Elec. Res. Corp.	TR-6-6025	
Tube Clamps	Birtcher	926-C	
Tube Clamp	Birtcher	926-H-6080	
Guide Pin Bushings	Cannon	AN-3064-8	
Coupling Nut	Cannon	AN-3066-8	
Knobs	Raytheon	70-3-2G, 70-1-1G, 8925301-17791	
Fuse Holders	Littelfuse	342003	
Nylon Cable Clamp	Burndy	HP-5N	
Nylon Cable Clamp	Burndy	HP-7N	
Pilot Bulb	General Electric	328	
Plug in Unit Receptacle Card) See Channel Selector Parts List			
Plug in Unit Receptacle) See Low Pass Filter Insert Parts List			
1/8" Bakelite Terminal Board) See Low Pass Filter Insert Parts List			
1/8" Bakelite Terminal Board) See Low Pass Filter Insert Parts List			

MODEL 67 CHANNEL SELECTOR UNIT REPLACEABLE PARTS

Symbol	Description	Manufacturer	Type and Tolerance		Function
R-1104	*	Electra	DC-1/2c	1%	1st Filter Amplifier Q Setting
R-1106	*	Electra	DC-1/2c	1%	2nd Filter Amplifier Q Setting
R-1108	*	Electra	DC-1/2c	1%	3rd Filter, Amplifier Q Setting
R-1110	*	Electra	DC-1/2c	1%	4th Filter Amplifier Q Setting
R-1314	250 K	Shallcross	P-34-E	1%	Discriminator Grid Return
R-1322	100 K	Helipot	AZ		Discriminator Centering Control
R-1401	100 K/200 K**	Electra	DC-1/2c	1%	Output Filter Element, Series R
R-1443	200 K***	Electra	DC-1/2c	1%	Output Filter Element, Divider
C-1102	*	El-Menco			1st Section Input Filter Tuning
C-1104	*	El-Menco			2nd Section Input Filter Tuning
C-1105	*	El-Menco			3rd Section Input Filter Tuning
C-1106	*	El-Menco			4th Section Input Filter Tuning
C-1306	*	El-Menco			Frequency Determing Capacity
L-1101	*Toroid		*		Input Filter
L-1102	*Toriod		*		Input Filter
L-1103	*Toriod		*		Input Filter
L-1104	*Toriod		*		Input Filter
	Plug in unit receptacle card	EMR	B-00036		(mates with B-00040)

* Factory Adjusted
** 100 K in 7.5% Units/ 200 K in 15% Units.
*** Used on 15% Units Only.


V-103B PIN 6 OR 8
V-201 PIN 5 +120 +80
V-203 PIN 2 +200 +70
V-301 OR V-302 PINS +100 -160
V-303B PIN 8 +100 -100
V-306 PIN 1 -200 -400
INPUT CONTROL
ZERO SIGNAL BALANCE CONTROL
BALANCE CONTROL
SUBCARRIER MONITOR JACK
SUBCARRIER MONITOR
INPUT LEVEL
WOW & FLUTTER INTO DISCRM
TO C-418
TO TERMINAL ON T-1
AMP. BALANCE
EXTER. GAIN #1A
EXTER. GAIN #1B
EXTER. GAIN #2
LOW IMPEDANCE OUTPUT
OUTPUT JACK
CONNECT PINS TO + SIDE OF EXTERNAL METER.
SUBCARRIER INPUT
115 VOLTS AC 60~ INPUT
EXTER. ZERO OFFSET
SUBCARRIER MONITOR
WOW & FLUTTER INTO DISCRIMINATOR
UNREG.
REG. ± 1%
REG. ± 1/2%
UNREG.
OUTPUT GAIN CONTROL SWITCH
SW-401
NOTE:
OUTPUT VOLTAGE RANGES (±) FOR FULL DEVIATION
SWITCH POSITION VOLTAGE RANGE
1 6-15
2 15-20
3 20-30
4 30-50
5 50-30
6 EXTERNAL
NOTE:
OUTPUT GAIN CONTROL SW. IN POSITION #1: CLOCKWISE ROTATION OF R-447 INCREASES RESISTANCE.
* FACTORY ADJUSTED
** THESE ARE COMPONENTS FOR STANDARD L.R.O.F.
*** R-1401 = 100K, R-1443 = OMIT } FOR ± 7.5% CIRCUIT
R-1401 = 200K, R-1443 = 200K } FOR ± 15% CIRCUIT
**** DISCRIMINATOR TUNING CAPACITOR
***** CLOCKWISE ROTATION INCREASES RESISTANCE R-1322, R-323, R-450
NOS. IN CIRCLES ARE CHANNEL SELECTOR UNIT PIN CONNECTIONS.
NOS. IN SQ'S ARE BAND PASS INPUT FILTER CARD TERMINAL CONNECTIONS.
UNLESS NOTED, CAPACITY VALUES ARE MICRO-FARADS.
DO NOT SCALE DRAWING
REVISIONS
A AUTH. #137
B COMP WITH AUTH #181
DATE 8-18-55
SCALE
DRAWN HB
CKD.
APP. WHD
ELECTRO-MECHANICAL RESEARCH INC.
RIDGEFIELD, CONNECTICUT
MAT'L.
FINISH
CIRCUIT DIAGRAM MODEL 67D SUBCARRIER DISCRIMINATOR
NO. REQ'D.
67D-#1
D-01999

EMR MODEL 67 SUBCARRIER DISCRIMINATOR

EMR Models 67D or 67F

Rear Cannon Connector Pin Functions

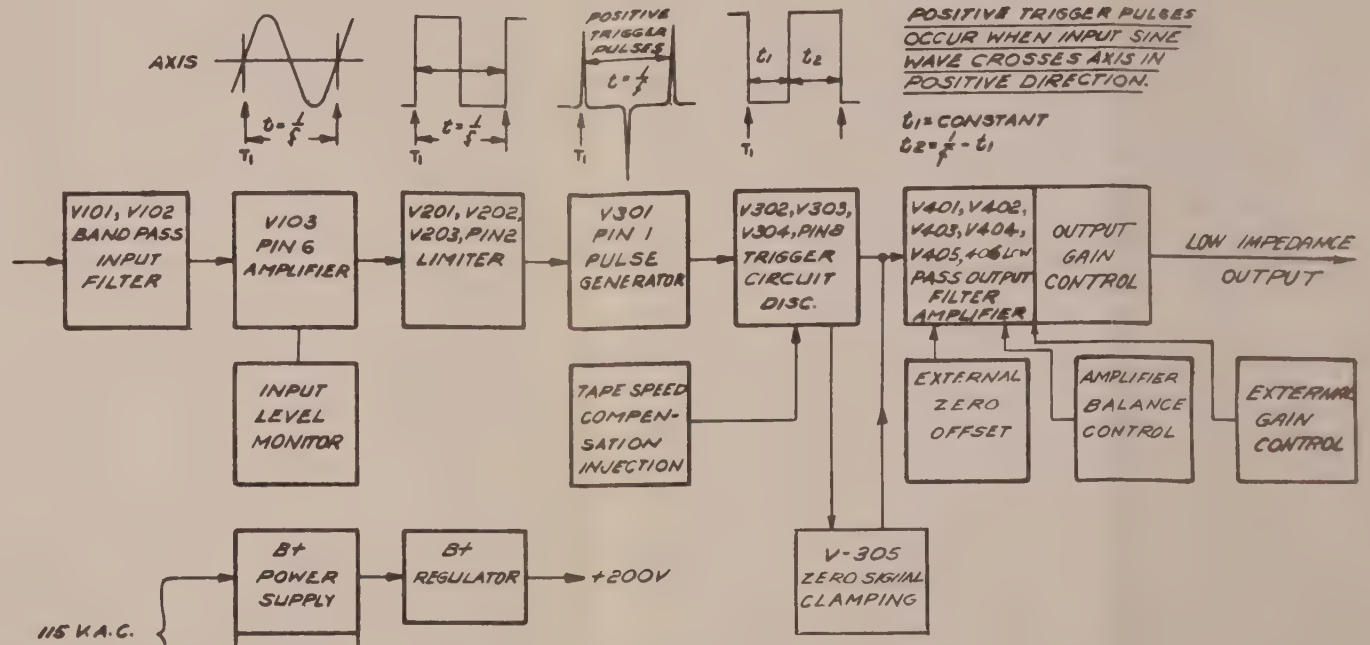
Pin No.	Connector Pin Function
A1	Subcarrier Input
A2	No connection
1, 2	Unregulated A-C Input
3, 4	Regulated A-C Input on Model 67F Other Models - No connection
5*	Remote Meter + Terminal } Jumper together if remote meter not used
6*	Remote Meter - Terminal }
7, 8	Low Impedance Output (Either Pin)
9	Ground Connection Available
10*	Ext. Gain No. 2 - See Dwg. B-01983. Jumper to Pin 8 if Ext. Gain not used
11	Ground Connection Available
12	Ground Connection Available
13	Ground Connection Available
14	Ground Connection Available
15	Ground Connection Available
16	200 Volts B+ Available
17	200 Volts B- Available
18	No connection
19*	External Zero Offset - Jumper to Ground if unused
20	No connection
21	No connection
22*	Wow and Flutter Compensation Input. Jumper to Ground if unused.
23	No connection
24*	Ext. Gain No. 1B } See Dwg. B-01983 for connection - Jumper together
25*	Ext. Gain No. 1A } if Ext. Gain not used
26	Ground Connection Available
27	Subcarrier Monitor (Same point as Input Jack - Front Panel)
28	Ground Connection Available
29	Ground Connection Available
30	Ground Connection Available

*For normal operation, these Jumper connections must be made.

DO NOT SCALE DRAWING ALL FRACTIONAL HOLES +1/64—0

J		E		DATE 4-12-57	ELECTRO-MECHANICAL RESEARCH INC.		
I		D		SCALE —	RIDGEFIELD, CONNECTICUT		
H		C		DRAWN E.P.	MAT'L. —	TOL. UNLESS NOTED	
G		B		CKD. E.P.G.	FINISH —	FRACTIONAL ± 1/64	
F		A		APP. W.N.D.		DECIMAL ± .005	
REVISIONS				NO. REQ'D. —	Cannon Connector Pin Functions		
					67	A-04452	

Bruning Diazogen Co., Inc., New York, N. Y. No. 186M Ageproof Tracing Vellum



DO NOT SCALE DRAWING

J		E		DATE 1-25-55	ELECTRO-MECHANICAL RESEARCH INC. RIDGEFIELD, CONNECTICUT
I		D		SCALE ~	
H		C		DRAWN F.P.	MAT'L. / TOL. UNLESS NOTED: FRACTIONAL ± 1/64
G		B		CKD.	FINISH / DECIMAL ± .005
F		A		APP.	BLOCK & WAVEFORM DIAGRAM
REVISIONS				NO. REQ'D.	67F-B1

MODEL 67 LOW PASS FILTER INSERT UNIT REPLACEABLE PARTS

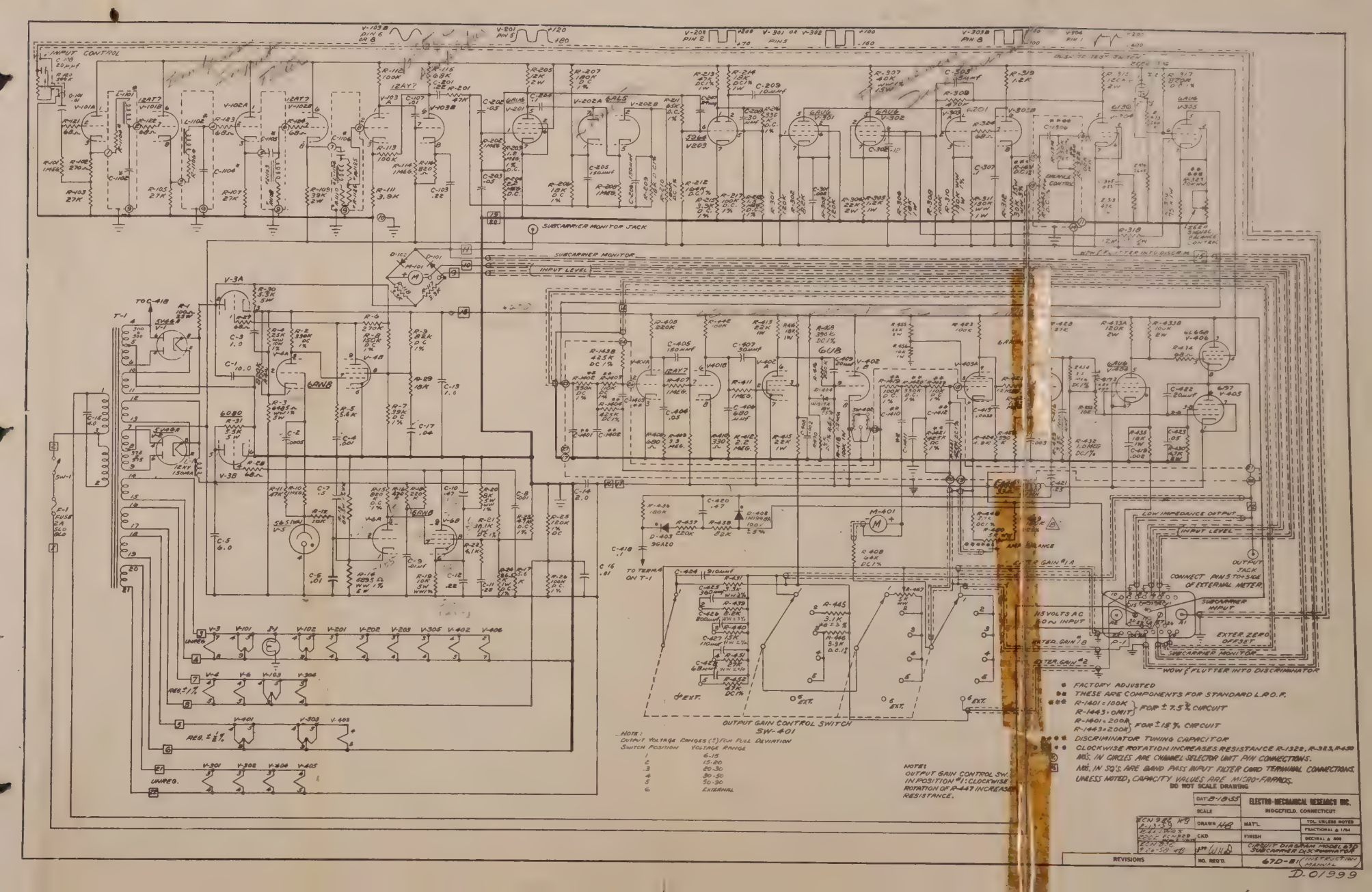
Symbol	Description	Manufacturer	Type and Tolerance		Function
R-1402	330 K	Electra	DC-1/2c	1%	Output Filter Element, Series R
R-1403	110 K	Electra	DC-1/2c	1%	Output Filter Element, Series R
R-1404	425 K	Electra	DC-1/2c	1%	Output Filter Element, Feedback R
R-1419	100 K	Electra	DC-1/2c	1%	Output Filter Element, Series R
R-1420	330 K	Electra	DC-1/2c	1%	Output Filter Element, Series R
R-1421	425 K	Electra	DC-1/2c	1%	Output Filter Element, Feedback R
R-1422	110 K	Electra	DC-1/2c	1%	Output Filter Element, Series R
C-1401	*				Output Filter Element, Shunt C
C-1402	*				Output Filter Element, Shunt C
C-1403	*				Output Filter Element, Feedback C
C-1410	*	El-Menco			Output Filter Element, Shunt C
C-1411	*	El-Menco			Output Filter Element, Shunt C
C-1412	*	El-Menco			Output Filter Element, Feedback C
R-1438	425 K	Electra	DC-1/2c		Zero Offset Voltage Setting
R-1441	470 K	Electra	DC-1/2c		Amplifier Balance Voltage Dropping
	Plug-in unit receptacle card	EMR	A-00011		(Mates with B-00040)
	1/8'' Bakelite Terminal Board	EMR	A-00109		Mounting Small Output Filter Parts
	1/8'' Bakelite Terminal Board	EMR	A-00110		Mounting Small Output Filter Parts

* Factory Adjusted

DISCRIMINATOR TUNING CAPACITOR (C-1306) VALUES

Subcarrier Band	Capacity (mmf.)	Type
400	6200	CM-30
560	4300	CM-30
730	3600	CM-30
960	2700	CM-30
1300	2000	CM-30
1700	1500	CM-20
2300	1100	CM-20
3000	820	CM-20
3900	620	CM-20
5400	470	CM-20
7350	330	CM-15
10500	240	CM-15
12300	200	CM-15
14500	160	CM-15
22000	110	CM-15
30000	82	CM-15
40000	62	CM-15
525000	47	CM-15
70000	33	CM-15

All Values Silvered Mica, El Menco, 500 Volt Rating, 5% Tol.

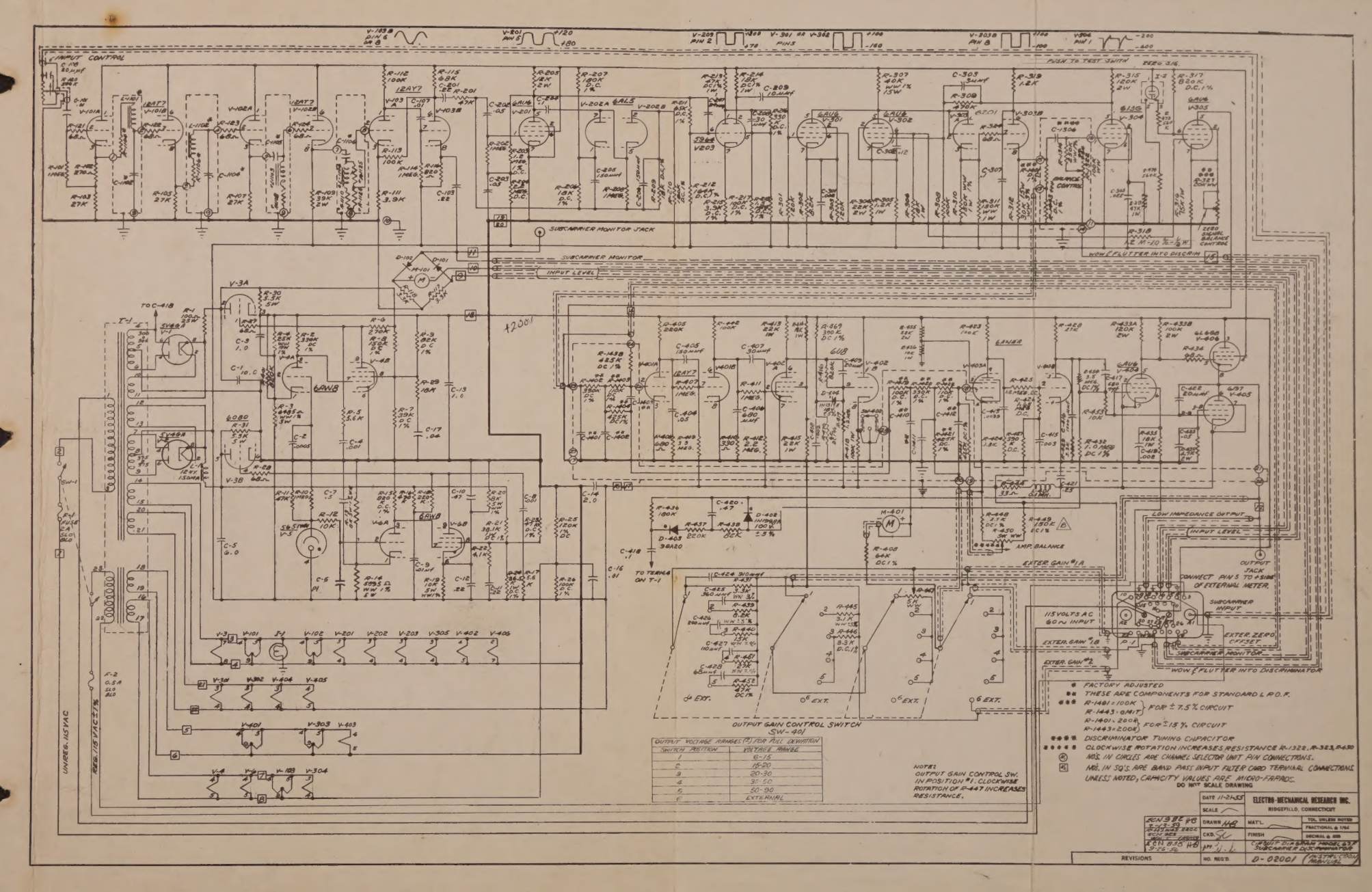


- FACTORY ADJUSTED
- THESE ARE COMPONENTS FOR STANDARD L.R.O.P.
- R-1401 = 100K, R-1443 = OMIT } FOR ± 7.5% CIRCUIT
- R-1401 = 200K, R-1443 = 200K } FOR ± 15% CIRCUIT
- DISCRIMINATOR TUNING CAPACITOR
- CLOCKWISE ROTATION INCREASES RESISTANCE R-1328, R-383, R-430
- NOS. IN CIRCLES ARE CHANNEL SELECTOR UNIT PIN CONNECTIONS.
- NOS. IN SQ'S ARE BAND PASS INPUT FILTER CARD TERMINAL CONNECTIONS.
- UNLESS NOTED, CAPACITY VALUES ARE MICRO-FARADS.

NOTE: OUTPUT VOLTAGE RANGES (±) FOR FULL DEVIATION

Switch Position	Voltage Range
1	6-15
2	15-30
3	30-50
4	50-90
5	90-150
6	External

NOTE: OUTPUT GAIN CONTROL SW. IN POSITION #1: CLOCKWISE ROTATION OF R-447 INCREASES RESISTANCE.


INPUT CONTROL
SUBCARRIER MONITOR JACK
SUBCARRIER MONITOR
INPUT LEVEL
WOW & FLUTTER INTO DISCRIM
PUSH TO TEST SWITH
BALANCE CONTROL
ZERO SIGNAL BALANCE CONTROL
LOW IMPEDANCE OUTPUT
INPUT LEVEL
OUTPUT JACK +5 TO +51DB OF EXTERNAL METER.
CONNECT PIN 5 TO +51DB OF EXTERNAL METER.
SUBCARRIER INPUT
EXTER. ZERO OFFSET
SUBCARRIER MONITOR
WOW & FLUTTER INTO DISCRIMINATOR
AMP. BALANCE
EXTER. GAIN #1A
EXTER. GAIN #1B
EXTER. GAIN #2
115 VOLTS A.C. 60 ~ INPUT
OUTPUT GAIN CONTROL SWITCH SW-401
TO TERM 4 ON T-1
TO C-418
115 VAC ± 1%
UNREG. 135 VAC
REG. 115 VAC ± 1%
F-1 FUSE 2A SLO BLO
F-2 0.5A SLO BLO
SW-1
T-1
12.6V 150MA
6AW8
6AU8
6AL5
6AN8A
6U8
6J7
6080
6BQ7A
6X4
6136
6146
6201
6SL7/1800
5Y3GT/G
5U4G
5V4G
12AT7
12AU7
12BH7
12AX7
12AY7
OUTPUT VOLTAGE RANGES FOR FULL DEVIATION
SWITCH POSITION | VOLTAGE RANGE
1 | 6-15
2 | 15-30
3 | 20-30
4 | 30-50
5 | 50-90
6 | EXTERNAL
NOTE: OUTPUT GAIN CONTROL SW. IN POSITION #1: CLOCKWISE ROTATION OF R-447 INCREASES RESISTANCE.
* FACTORY ADJUSTED
** THESE ARE COMPONENTS FOR STANDARD L.P.O.F.
*** R-1401 = 100K, R-1443 = 9.41K FOR ± 7.5% CIRCUIT
R-1401 = 200K, R-1443 = 200K FOR ± 15% CIRCUIT
**** DISCRIMINATOR TUNING CAPACITOR
***** CLOCKWISE ROTATION INCREASES RESISTANCE R-1328, R-323, R-430
NOS. IN CIRCLES ARE CHANNEL SELECTOR UNIT PIN CONNECTIONS.
NOS. IN SQ'S ARE BAND PASS INPUT FILTER CARD TERMINAL CONNECTIONS.
UNLESS NOTED; CAPACITY VALUES ARE MICRO-FARADS.
DO NOT SCALE DRAWING
ELECTRO-MECHANICAL RESEARCH INC.
RIDGEFIELD, CONNECTICUT
DATE 11-21-55
SCALE
DRAWN HG
CKD. SL
APP.
MAT'L.
FINISH
TOL. UNLESS NOTED
FRACTIONAL ± 1/64
DECIMAL ± .005
CIRCUIT DIA. & PARTS LIST, L.F. SUBCARRIER & DISCRIMINATOR
REVISIONS
NO. REQ'D.
D-02001